

DOCUMENT RESUME

ED 062 903

HE 002 945

TITLE Postgraduate Education: Structures and Policies.
INSTITUTION Organisation for Economic Cooperation and
Development, Paris (France).
PUB DATE Feb 72
NOTE 302p.
EDRS PRICE MF-\$0.65 HC-\$13.16
DESCRIPTORS College Graduates; *Educational Research; *Graduate
Study; *Higher Education; *International Education;
Professional Continuing Education; Research;
*Scientific Research

ABSTRACT

As part of its continuing work on problems of higher education, the Directorate for Scientific Affairs of the Organization for Economic Cooperation and Development (OECD) carried out an investigation into the issues and policies concerning the development of postgraduate education in OECD member countries. The present volume incorporates the results of this study. The General Report presents the main problems, trends, and issues confronting member countries, as well as the policy options available to them. This is followed by a series of country case studies that provide the bulk of the material on the basis of which the main problems in the General Report were formulated. It is one of the main implications of this report that the distinctions that are traditionally drawn between science policy on the one hand and education policy on the other may no longer be meaningful as operational concepts. (Author/HS)

ED 062 903

**POSTGRADUATE EDUCATION:
STRUCTURES AND POLICIES**

**L'ENSEIGNEMENT UNIVERSITAIRE
DE TROISIÈME CYCLE:
STRUCTURES ET POLITIQUES**

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRO-
DUCED EXACTLY AS RECEIVED FROM
THE PERSON OR ORGANIZATION ORIG-
INATING IT. POINTS OF VIEW OR OPIN-
IONS STATED DO NOT NECESSARILY
REPRESENT OFFICIAL OFFICE OF EDU-
CATION POSITION OR POLICY.

**ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
ORGANISATION DE COOPÉRATION ET DE DÉVELOPPEMENT ÉCONOMIQUES**

PARIS - FEBRUARY 1972

HE 062 945

POSTGRADUATE EDUCATION:
STRUCTURES AND POLICIES

L'ENSEIGNEMENT UNIVERSITAIRE
DE TROISIEME CYCLE:
STRUCTURES ET POLITIQUES

82577

PREFACE

As part of its continuing work on problems of higher education under the programme of work of the OECD Education Committee, the Directorate for Scientific Affairs carried out an investigation into the issues and policies concerning the development of postgraduate education in Member countries.

The present volume incorporates the results of this study. It is made up of the General Report presenting the main problems, trends and issues confronting Member countries, as well as the policy options available to them, followed by a series of country case studies (reproduced as Annexes in their original version only) which provided the bulk of the material on the basis of which the main problems were formulated in the General Report. The issues covered in this study, because of their close inter-relationships with the higher education system as well as with the research system, are becoming of growing significance of no less concern to science than to educational policy-makers. It is, in fact, one of the main implications of this report that the distinctions which are traditionally drawn between science policy on the one hand and education policy on the other may no longer be meaningful as operational concepts.

The whole of this report, which is issued under the responsibility of the Secretariat, was prepared by Stuart Blume, in his capacity as consultant to the Secretariat, except for the case study on France, which is the work of Jean-Pierre Pellegrin, member of the Secretariat.

PREFACE

Poursuivant ses travaux sur les problèmes de l'enseignement supérieur, dans le cadre du programme d'activités du Comité de l'Education de l'OCDE, la Direction des Affaires Scientifiques a réalisé une étude sur les structures et les politiques liées au développement de l'enseignement universitaire de troisième cycle dans les pays Membres.

On trouvera dans le présent volume un exposé des résultats de cette étude. Cet exposé comprend le Rapport général, où sont présentés les principaux problèmes, tendances et difficultés que connaissent les pays Membres, ainsi que les diverses options politiques qui s'offrent à eux, et une série d'études de cas par pays (reproduites en annexes dans leur version originale uniquement), qui ont fourni l'essentiel des données sur lesquelles on s'est appuyé pour exposer les principaux problèmes dans le rapport général. Les questions dont traite cette étude, du fait qu'elles sont étroitement liées au système d'enseignement supérieur comme au système de recherche, revêtent une importance croissante aussi bien pour les responsables de la politique de la science que pour ceux de la politique de l'éducation. En fait, il ressort essentiellement de ce rapport que la distinction que l'on établit traditionnellement entre la politique de la science et la politique de l'éducation n'a peut-être plus grand sens du point de vue opérationnel.

Ce rapport, qui est publié sous l'égide du Secrétariat, a été entièrement rédigé par M. Stuart Blume, consultant auprès du Secrétariat, à l'exception de l'étude de cas sur la France, qui est due à M. Jean-Pierre Pellegrin, membre du Secrétariat.

POSTGRADUATE EDUCATION:

STRUCTURES AND POLICIES

TABLE OF CONTENTS

	<u>Page</u>
GENERAL REPORT	5
ANNEX A : POSTGRADUATE EDUCATION IN CANADA	99
ANNEX B : L'ENSEIGNEMENT UNIVERSITAIRE DE TROISIEME CYCLE EN FRANCE	127
ANNEX C : POSTGRADUATE EDUCATION IN THE FEDERAL REPUBLIC OF GERMANY	169
ANNEX D : POSTGRADUATE EDUCATION IN NORWAY	191
ANNEX E : POSTGRADUATE EDUCATION IN THE UNITED KINGDOM	217
ANNEX F : GRADUATE EDUCATION IN THE UNITED STATES	249
ANNEX G : PROBLEMS OF POSTGRADUATE EDUCATION IN DEVELOPING OECD MEMBER COUNTRIES	295

L'ENSEIGNEMENT UNIVERSITAIRE

DE TROISIEME CYCLE:

STRUCTURES ET POLITIQUES

TABLE DES MATIERES

	<u>Page</u>
RAPPORT GENERAL	47
ANNEXE A : POSTGRADUATE EDUCATION IN CANADA	99
ANNEXE B : L'ENSEIGNEMENT UNIVERSITAIRE DE TROISIEME CYCLE EN FRANCE	127
ANNEXE C : POSTGRADUATE EDUCATION IN THE FEDERAL REPUBLIC OF GERMANY	169
ANNEXE D : POSTGRADUATE EDUCATION IN NORWAY	191
ANNEXE E : POSTGRADUATE EDUCATION IN THE UNITED KINGDOM	217
ANNEXE F : GRADUATE EDUCATION IN THE UNITED STATES	249
ANNEXE G : PROBLEMS OF POSTGRADUATE EDUCATION IN DEVELOPING OECD MEMBER COUNTRIES	295

GENERAL REPORT

GENERAL REPORT

TABLE OF CONTENTS

	<u>Page</u>
<u>ABSTRACT</u>	8
I. <u>INTRODUCTION</u>	11
II. <u>THE NATURE OF POSTGRADUATE EDUCATION</u>	13
III. <u>THE STATISTICS AND GROWTH OF POSTGRADUATE EDUCATION</u>	17.
IV. <u>THE SOURCES OF GROWTH</u>	21
A. Student Choice	22
B. Specialisation of Knowledge	23
C. The Demand for Scientists	23
D. The Dynamics of the Higher Education System	26
V. <u>SOME CURRENT ISSUES</u>	29
A. How should Postgraduate Study be Organised?	29
B. The Finance of Postgraduate Study	31
C. Some Problems of Employment	35
D. Postgraduate Study Abroad	39
E. The Planning of Postgraduate Education	41
F. Some Final Considerations	44

ABSTRACT

Postgraduate education is of growing significance to policy-makers, whether concerned principally with higher education or principally with research, and yet it remains a complex and ambiguous term. For simplification this paper considers three types of postgraduate education: professional training (e.g. for medicine or the law); further instruction in the subject of the student's first degree (e.g. for a master's degree); education in research. It is with the last that the paper is principally concerned: that is, study which follows upon the receipt of a university-level degree and which involves at least an element of research, often leading to the doctorate. There is also a particular emphasis upon the sciences. Although in some OECD countries there is as yet no postgraduate cycle of higher education, in most of those in which it does exist its growth has been exceedingly rapid - more rapid than the growth in earlier cycles of higher education. A doubling within 5-6 years in the number of higher degrees awarded annually has been far from uncommon.

Growth of higher education depends upon the provision of resources both by governments and (voluntarily and individually) by students. At the postgraduate level the provision of research funds by governments is particularly relevant. The growth of postgraduate and more particularly doctoral education can be ascribed to the complex interaction of a variety of factors: changing student choice, the growth of knowledge, increasing demand for scientists, and the growth and internal dynamics of the higher education system itself.

Any policy towards postgraduate education in research must deal with certain crucial issues, and the latter half of this paper is concerned with the discussion of some of these issues. They may be summarised under three headings:

(a) Problems of Organisation and Finance

Study of individual systems of higher education shows significant national differences in the following:

- (i) The concentration of doctoral work in a limited number of institutions compared with first degree level work, and frequently, and increasingly, a degree of institutional specialisation.
- (ii) The extent to which it is possible for advanced students to obtain doctorates for work done whilst in employment. This may be totally forbidden, it may be possible within a limited number of government departments or laboratories, or it may be relatively easy. Furthermore, the degree of surveillance exercised by educational institutions over their external research students differs greatly. Finally, students may be attached to a university; or a special degree-granting body may be established for the purpose (such as the C.N.A.A. in the United Kingdom).
- (iii) The formal instructional component of research-based education ranges from virtually nil in some fields and some countries to two years of courses in others. The courses may be used to prepare the student for his specialist research, or they may be used to supplement his specialist work by, for example, instruction in pedagogic methods (notably in the USSR). Too little instruction may mean that the student embarks upon his research in a state of inadequate preparation; too much, that the total period of study is excessively prolonged.

- (iv) Methods of finance vary greatly. Emphasis may be placed upon finance from primarily scientific sources (e.g. from research councils) or from educational sources (e.g. ministries of education, foundations). Research students financed from scientific sources may be supported largely from research grants or from the fellowship funds of research councils, although in general both will be involved to a greater or lesser extent. Over-emphasis upon either one or the other may give rise to serious problems. In other countries, research students may be financed principally from specifically educational funds, which may be either grants or loans. It has been suggested that the postgraduate level is particularly appropriate for the introduction of a loan finance system. But again there are rather well-known advantages and disadvantages attaching to each alternative.

It is suggested in this report that national preferences on each of these issues will derive, explicitly or implicitly, from the view held of postgraduate education: professional (research used to train in research methods) or educational (research as a didactic method). Coherent policy requires that this view be made explicit and that decisions on the issues raised above flow from it.

(b) The Employment of Doctoral Graduates

The professionalised doctorate of North America and the UK (the Ph.D.) has traditionally been regarded as a virtual guarantee of a research career, preferably in the university system. In times of greatly expanding higher education systems and high demand for research personnel this creates no problems. When university systems cease to expand, whether for demographic or financial reasons, or when the demand for research scientists falls off, it may create difficulties in countries with a professionalised doctorate. Although there is little or no evidence of a flattening off in university enrolments, in a number of countries the recent high growth rates in R & D expenditure have been severely cut. The demand for scientists has consequently fallen. In North America and the UK there is evidence that new Ph.D.s are now finding it hard to obtain employment which they regard as suitable, and there is also evidence of scientific unemployment. The recent development of postdoctoral education is rather significant. This may be regarded as a response to the growth in the scientific knowledge needed to embark upon an independent career, or it may be regarded as a response to the lack of permanent posts - that is, a situation of concealed unemployment. It is important to distinguish the likely future demands of the higher education system, and of other employers - educational, governmental and industrial - for doctoral graduates. How essential to employment, in industry or in various governmental posts, is the level of skill acquired in working for the doctorate? On this point industry views differ, but then of course industrial enterprises themselves differ. It remains true that relatively little is known of the utilisation of manpower for this level of specialisation. Finally, it may be asked what is a suitable scale of provision for postdoctoral education in the sciences.

(c) The Planning of Postgraduate Education

There are important conceptual difficulties in an attempt to formulate specific and detailed plans for the provision of higher education, on whatever basis. Manpower considerations imply difficulties of the following kinds:

- (i) supply is hard to assess both because of the inexact correlation with the output of the educational system and because of the uncertainty of student career choice;

- (ii) supply and demand are not independent variables, they interact through the labour market;
- (iii) there are dangers in the attempt to regulate the number of places in the light of employers' assessment of the current situation, however accurate the assessment;
- (iv) it is not clear whether "need" or "demand" should be related to supply; most national forecasts of scientific manpower have used the former, but it is a vague concept;
- (v) there are ideological objections to basing educational provision upon manpower plans; for many countries social demand is the essential determinant.

There is also an important difficulty which stems from the support of university research (particularly in the physical sciences) from a variety of sources, both governmental and non-governmental. It is a generally accepted tenet of science policy that a high degree of "user finance" of academic research is a desirable state of affairs. Nevertheless, to the extent that multiple support is found, alternative foci of power exist, possibly with different conceptions of the role of research education and potentially hard to co-ordinate. Research and manpower considerations may therefore indicate different optimum situations of the distribution of financial responsibility. A related difficulty in the planning of postgraduate education in a number of OECD countries derives from the fact that educational finance is frequently a provincial responsibility, whereas the support of research almost always devolves upon the federal government. The planning of postgraduate education may easily fall, by default, between the two stools of educational policy on the one hand and science policy on the other. Perhaps the time has come to recognise its own particular nature and to distinguish its particular function, and to take the consequences of this situation for the organisation of the planning process in this field.

Final considerations

Finally, it is suggested that in the pure sciences - although not in other disciplines - there are important international pressures towards a uniform Ph.D.-type degree system. It is important to evaluate the implications of such a degree system in the light of the current experience of countries where such a system has been in practice for some time. It is also important to recognise that such a degree, in the sciences, must not be the only alternative at the postgraduate level; there is a real need for non-research alternatives.

I. INTRODUCTION

Although postgraduate education has perhaps not been the major focus of concern in discussion of higher education problems up to the present time, there is no doubt that its importance is being increasingly recognised. Many OECD country reports, whether oriented towards the problems of higher education or towards those of science policy, are discussing the specific problems of the third cycle. It is important to remember that this is an issue of no less concern to science policy-makers than to education policy-makers. Postgraduate students not only study and teach but they contribute very substantially to the academic research effort. Thus, we find a growing volume of reports, a growing number of committees, for whom the problems of postgraduate training and research - especially in the natural sciences - are either the main or an important subsidiary focus of attention. Thus, in the United States, the National Science Board published two important documents on policy for graduate education in 1969 (1), and subsequently carried out a study to determine the impact of cuts in Federal expenditure on graduate work (2). These cuts and the growing unemployment of Ph.D.s in the USA have resulted in scientific bodies, such as the American Institute of Physics, being particularly preoccupied with this problem. In Canada, recent reports of the Science Council and the National Research Council (3), as well as the published volume of the Report of the Senate Special Committee on Science Policy (4), have been motivated to discuss this issue - many of them by the problem of Ph.D. unemployment and overproduction.

In Japan, a committee of enquiry of the Association of National Universities was appointed to look into the problems of introducing new types of graduate education, and how graduate education should be organised as between the variety of higher educational institutions in Japan. A Preliminary Report appeared in November 1969 (5). In France, although recent reforms have been more concerned with the urgent problems of first and second cycle higher education and the overall problems of university structures, they have nevertheless involved the suppression of the postgraduate diplôme d'études supérieures and the introduction of the maîtrise degree. In Germany, a massive programme of Federal aid to postgraduate education is being introduced during 1971. In the UK, the Swann Report on flows into employment of science graduates as well as a number of other reports have been very concerned with an apparent mismatch between doctoral education and the needs of employers. The need to redirect substantial numbers of students from the university/research-oriented Ph.D. towards the more vocationally-oriented master's degree courses which are available has been central to the thinking of the Council for Scientific Policy and the Science Research Council in recent years. In a number of the OECD countries which do not have a postgraduate degree akin to the Ph.D. (e.g. Italy, Norway, Netherlands) the creation of such a degree has been urged by many of those concerned specifically with the future of basic science.

-
- (1) See Annex F to this report.
 - (2) Impact of Changes in Federal Science Funding Patterns on Academic Institutions
National Science Foundation (Washington, October 1970).
 - (3) See Annex A to this report.
 - (4) A Science Policy for Canada, Report of the Senate Special Committee (Ottawa 1970).
 - (5) Standing Committee No. 1: "Innovating Graduate Course", First Preliminary Report.
Association of National Universities (Tokyo, November 1969).

Finally, although it is not an issue dealt with in this paper, it is important to recognise that in-career retraining (or "continuing education") is no less an aspect of postgraduate education than are many of the issues with which we deal in the following pages. The only justification for ignoring it here is its very importance; it is simply too large an issue to be dealt with in passing fashion. There are, of course, other issues worthy of discussion which are not discussed here, such as the status of postgraduate students in universities - which is frequently ambiguous and uncertain - and their contribution to undergraduate teaching.

To summarise, it could be suggested that because of its inter-relationships both with the higher education system and with the research system, postgraduate education is now an issue of growing significance. Recent developments in science policy have added substantially to its relevance in many countries. It cannot be omitted from a discussion of the future place of research in the "mass university": any growing separation of research from education will force an appraisal of postgraduate work upon the policy-maker.

This paper is based largely upon previous OECD work on the growth of higher education (1)(2) and upon a series of country case studies dealing with postgraduate education in Canada, France, the Federal Republic of Germany, Norway, the United Kingdom and the United States of America. These case studies are annexed to this report. A final annex deals briefly with the special problems of the developing OECD Member countries.

The report is organised as follows. In section II postgraduate education is defined in the context of this paper. In section III the growth of postgraduate education is charted in statistical terms and in section IV some of the factors which have given rise to this growth are discussed. Finally, but perhaps most important of all, section V discusses some issues which appear of particular relevance to policy in this field at the present moment.

-
- (1) Development of Higher Education 1950-1967, Statistical Survey,
OECD (Paris, 1970).
 - (2) Development of Higher Education 1950-1967, Analytical Report,
OECD (Paris 1971).

II. THE NATURE OF POSTGRADUATE EDUCATION

In later sections the statistical growth of postgraduate education will be outlined and an attempt made to describe some of the factors which have given rise to this growth. First, however, we must describe what is meant in this report by postgraduate education, in terms of content and structure. It is difficult to make international comparisons here, principally because higher degrees (e.g. the doctorate) have very different implications from country to country in terms of intellectual and social status, function and content. Few educational concepts are as ambiguous.

It is probably true to say that postgraduate education can be taken to encompass the following types of education: education in research methods (doctoral education), professional training, and further instruction in the subject of the student's first degree. The latter may be a one- or two-year course following immediately upon the earlier cycle of studies, or it may be an upgrading course of anything between one month and one year in mid-career. It may or may not lead to a further degree or diploma. Professional training takes many forms even within individual professions such as law, medicine or education. There are important differences between countries. In law and in medicine, for example, training is generally determined in part by professional bodies, often of great age, and jealously guarding their traditional privileges. Frequently, therefore, professional training is divided between the formal education system and an on-the-job training of an apprenticeship kind. The exact division of the overall training of a lawyer or a doctor between the education system on the one hand and extra-mural study on the other differs widely from country to country and may be principally the result of traditional status considerations. Another important difference is found between countries in the organisation even of the formal part of the professional training. How much of the formal (intra-mural) training of a lawyer or a teacher is undergraduate and how much postgraduate? Consider the training of teachers for example. In the USA a postgraduate M.Ed. is generally necessary for high school teaching, although local regulations differ. In the UK until very recently graduates could teach in schools without any pedagogical instruction. This is now in the process of being changed and soon a one-year postgraduate teaching diploma will be required. In France various alternative postgraduate qualifications exist, including agrégation and CAPES. In law, British students enter the on-the-job part of their training immediately after graduating, whereas American students proceed first to postgraduate work in law school.

Research training is in a sense less complicated because traditional professional status considerations are not involved, but it is in a sense more complicated because the extent to which it is also a professional training differs between countries. In other words, the extent to which a professional scientist needs to supplement his formal university (doctoral) training in order to be accepted as a member of the scientific community differs between countries.

In only one significant respect is postgraduate education less complicated than the educational cycles which precede it: it is offered by a far smaller number of educational institutions than are lower qualifications. Excepting the on-the-job training, which may be controlled by the professional associations, postgraduate education is concentrated in a relatively small group of university institutions in each country. In the USA, for example, whereas bachelor's degrees are offered by some 2,000 institutions only about 700 award the master's degree and only 200-300 the Ph.D.

This report is limited almost entirely to what we have called research training and does not refer to the very particular problems of education for the traditional professions. In other words, the report is limited to study which follows on the receipt of a university-level degree and which involves at least an element of research. The periods of study in a few countries which fall within this definition are indicated in the diagram below, which relates particularly to the pure sciences.

Lower Boundary		Upper Boundary	Average Duration	Other Higher Degrees
			Years	
Canada	Bachelor's/Master's	Ph.D.	5-6	Doctorat d'Etat
France	Licence/Maitrise	Doctorat de 3ème cycle	3½	
Germany	Diploma/State Exam.	Doctorate	2-4	Dr.Phil.
Norway	Cand.Mag.	Cand.Real.	2½	
UK	Bachelor's/Master's	Ph.D.	3½	
USA	Bachelor's/Master's	Ph.D.	5-6	

In the sciences, for reasons which will be discussed below, the distinction between pregraduate and postgraduate work is slightly clearer than it is in the arts or philosophical disciplines. Thus in Germany, for example, the doctorate in the sciences is essentially a postgraduate degree: some 86% of science doctors have taken an earlier degree compared with only 4% in the disciplines of the philosophical faculties. In other words, the philosophical faculties maintain the use of the doctorate as the traditional termination point of university education. Recent reforms in Germany (and in German-Switzerland) have included the introduction of the degree of M.A. (licence), which is a shorter alternative first degree in the philosophical faculties for those students who wish neither to take the qualifying state examination for teachers (in lieu of a degree) nor to spend an extremely long time working for their doctorate.

In France, too, differences exist on the one hand between the degree structures in the sciences and in the humanities, and on the other hand between some of the other faculties. In the Faculties of Sciences and of Letters, the system is as follows: the long, optional second cycle of higher education (maitrise) is followed by a year of advanced study designed to confer a detailed understanding of the field in which the student will do his research. This year leads to the diplôme d'études approfondies (D.E.A.). Then follow one to three years of research at the end of which the student submits a thesis for the third cycle doctorate. This system of degrees was introduced first in the sciences, then in letters. Until 1963, the only doctorate available in the Faculty of Law and Economics was the doctorat d'Etat requiring the preparation of one thesis and some 5-10 years of study and research. In 1963, a third cycle doctorate was introduced, short and more formalised in its requirements. The doctorat d'Etat, in all fields, retains its importance as the essential passport to a university Chair. Thus, as in Germany, one finds old and new systems superimposed on one another; a new research degree, like the Ph.D., co-existing with the traditional doctorate.

This is true of many countries in Europe. New structures have been added to old ones, partly as a result of the inordinate length and hence high failure rates of traditional degrees, and partly as a result of the particular needs of natural scientists. In the natural sciences one finds that common needs have given rise to pressures towards equivalence in all countries. The old systems, even when modified as in Germany so as to include an undergraduate stage, do not give an essentially professional qualification. The German

doctorate in science, or the Norwegian cand. real., are not the marks of professional legitimation which scientists increasingly require. In these countries one finds that scientists are increasingly calling for a relatively short professional doctorate - a Ph.D. Even greater are the problems of those countries (such as Italy, the Netherlands) which have failed to make even minor changes to their traditional systems. The general internationalism and professionalism of science, and the particular attraction of the US universities with their general Ph.D. requirement, have together created a pressure towards equivalence which does not exist in other fields. The pressure is towards a degree like the American Ph.D. involving both supervised research and advanced instruction. Postgraduate degrees, even in science, frequently lack one or other of these components. In other words, the British doctorate, for example, until recently included very little in the way of coursework; in biology, for instance, perhaps only 10% of university departments offer such instruction. In relatively few departments must students pass any examination on this postgraduate teaching. In Germany and in Norway the problem is a different one: students who have started to work on their theses receive relatively little supervision and are left to cope as best they can. In France, as we have seen, reforms have led to a situation in which advanced instruction is now tested by the examination leading to the diplôme d'études approfondies (1). In the USA, the majority of candidates for the doctor's degree take the master's degree first. Only in chemistry among major academic disciplines is this not the case (only 40%); in all disciplines 79% of doctorate recipients have first taken a master's. Although this is valuable as a formal test of the student's knowledge, it has produced a situation in which the master's degree has significantly declined in status and is now regarded as no more than a stage towards the Ph.D., or a mark of failure to complete the latter.

The exact natures of individual degree systems are discussed in the case studies. The above discussion was intended to demonstrate the problems in making such comparisons and also to set in context some of the issues discussed below. The most significant conclusion to be borne in mind is the co-existence of old and new systems in most countries, and the almost universal pressure towards the introduction of a Ph.D.-type degree in the sciences.

(1) Or, for those who do not seem capable of carrying on with research the qualification is awarded of attestation d'études approfondies.

TABLE 1
HIGHER DEGREES AWARDED AND DISTRIBUTION BY FIELD

	Numbers of Higher Degrees Awarded in All Fields				% Distribution by Area of Study 1965/6							
					Pure Science	Technology (inc. Architt.)	Agriculture	Medical Subjects	Humanities and Fine Arts	Education	Law	Social Sciences
	1950-51	1960-61	1965-66	1966-67								
Austria (1)(2)	...	482	753	803	-	8.9	3.8	0.3	-	-	73.3	13.7
Belgium (3)	118	196	210	276	46.2	4.8	5.7	1.9	31.0	0.4	0.5	9.5
Denmark	...	50	63	...	14.0	4.6	6.3	48.8	22.1	-	2.1	2.1
Finland	106	174	343	302	28.3	16.3	5.2	17.5	16.3	-	6.1	10.2
France	(1951/2) 514	5,110	8,555	11,213	37.7	-	-	1.1	43.5	-	17.8	-
Germany (1)	...	5,244	5,413	...	21.4	9.0	7.0	47.5	0.8	-	9.6	4.7
Greece	...	...	293	192	9.6	4.1	1.3	76.5	5.1	-	2.4	1.0
Iceland	-	-	-	-	-	-	-	-	-	-	-	-
Ireland	...	625	955	...	6.8	2.7	2.0	8.4	13.2	61.8	0.9	4.3
Italy	-	-	-	-	-	-	-	-	-	-	-	-
Luxembourg	-	-	-	-	-	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	-	-	-	-
Norway	168	151	393	...	51.6	0.7	1.3	6.4	33.0	-	0.5	6.3
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Spain	...	699	615	540	26.7	-	2.9	36.7	18.2	-	11.5	3.9
Sweden	360	521	749	903	30.6	18.7	3.7	15.1	20.4	-	0.7	10.8
Switzerland	662	553	640	752	40.5	3.9	3.1	-	18.3	-	12.5	21.7
Turkey	...	...	209	236	7.7	15.8	1.9	51.7	10.5	-	3.3	9.1
United Kingdom	...	11,245	17,448	20,217	17.9	10.7	1.5	10.9	38.3	10.9	-	9.8
Yugoslavia	42	232	593	582	19.6	11.8	16.4	13.7	19.5	0.8	4.4	13.8
Canada	...	2,751	5,930	7,033	18.8	10.3	2.9	4.0	21.3	16.8	0.2	25.8
Japan	...	3,665*	9,806	11,789	13.6	27.4	6.6	29.1	13.7	0.1	-	9.6
United States	72,470	88,844*	159,011	178,513	13.8	11.3	1.8	2.1	18.7	36.1	0.6	14.3

(1) Requiring a previous degree
(2) Austrians only
(3) Doctorates
... Data not available

* 1961-62
/ 1964-65

Source: Development of Higher Education 1950-67, Statistical Survey and Analytical Report (OECD 1970 and 1971).

III. THE STATISTICS AND GROWTH OF POSTGRADUATE EDUCATION

Table 1 shows the number of higher degrees awarded in selected years in OECD Member countries as well as their distribution by areas of study. Taking this distribution first, there are a number of features which are of interest.

One might note, for example, that the percentages of higher science or technology degrees awarded in developing Member countries are rather low (with the exception of Yugoslavia and to some extent Spain). By contrast, in many of the smaller industrialised countries emphasis is very significantly upon the sciences. Some countries show degree patterns biased towards the humanities and letters, others towards medicine, the USA towards education. Others, again, are missing entirely from the table. Ultimately, one is struck less by any regularities in these data than by the lack of regularities. The fact is that no level of education is subject to so much variation, no level of education is employed in so many ways, for so many purposes, as this one.

It has been by a process of juxtaposition of the manpower needs of science, technology and the economy upon traditional and often inflexible systems of higher education that postgraduate education has developed in Europe. Most European countries are passing through a period of experimentation in which old and new systems of postgraduate study co-exist. The statistical fluctuations - which would be magnified greatly if changes over time in subject distributions had been included - are thus principally a reflection of these two factors: the diversity of function and the state of flux obtaining.

The experimentation has not been on a small scale. Indeed, if there is one generalisation which can be made here it is that the rate of growth of postgraduate education has been astonishing. A doubling in 5-6 years in the number of higher degrees awarded has been almost commonplace (Table 2). The magnitude of this expansion is brought out most forcibly by comparison with the growth of lower level higher education.

For 7 out of the 12 countries tabulated in Table 2 the output of higher degrees expanded at a higher annual growth rate than the output of first degrees between 1960-61 and 1965-66. Germany showed no growth at either level. Only for Sweden and Switzerland was first degree level expansion substantially the higher. In Japan and Yugoslavia the difference was phenomenal.

There are many indices which could be used to measure the relative growth of second and third cycle higher education: changes in ratios of degrees awarded at each level, changes in relative expenditure (if these can be found), changes in relative enrolment, changes in transition ratio. The general principle that postgraduate education is growing more rapidly than undergraduate education in the majority of countries could be established by considering any of these. For the education planner - concerned with the provision which must be made for higher education - the last two are of particular significance. (Science policy-makers may be more concerned with degrees, and flows into the economic system.) The relative enrolments - if combined with any knowledge of relative costs - give some concept of the share of resources which each level of higher education absorbs. This is clearly an important datum.

TABLE 2
AVERAGE ANNUAL GROWTH RATES (1960-61 - 1965-66) IN
DEGREES AWARDED IN SELECTED COUNTRIES

	First Degree Level		Higher Degree Level			
	Number awarded 1960/61	% Growth 1965/66	Below doctorate		Doctorate	
			Number awarded 1960/61	% Growth 1965/66	Number awarded 1960/61	% Growth 1965/66
Belgium	4,173	5,332	-	-	196	1.4
Canada	20,085	38,120	2,448	5,227	303	15.5
Finland	2,526	4,062	578	1,043	88	10.4
France	13,462	23,557	3,799	5,604	1,311	15.4
Germany	21,211	21,504	-	-	6,246	0.1
Japan	121,979	178,279	2,612*	5,938	1,053*	28.6
Norway	1,016	1,643	119	334	32	11.7
Sweden	4,067	6,454	330	510	191	4.5
Switzerland	1,776	2,463	-	-	553	2.9
United Kingdom	27,176	38,696	-	-	11,245 ^{a)}	8.7
United States	401,784	555,613	78,269	140,772	10,575	11.6
Yugoslavia	11,548	12,418	98	457	232	

* 1961/62

a) Masters and Doctorate.

b) Regulations changed.

TABLE 3
CHANGING RELATIVE ENROLMENTS - ALL THIRD CYCLE
TOTAL (%)

	<u>1938-39</u>	<u>1946-47</u>	<u>1952-53</u>	<u>1955-56</u>	<u>1960-61</u>	<u>1961-62</u>
United Kingdom	6.2 <u>1966-67</u> 17.4	5.1 <u>1968-69</u> 17.9	14.4	14.9	16.6	17.1
Canada	<u>1920-21</u> 1.8 <u>1964-65</u> 7.8	<u>1930-31</u> 4.3 <u>1965-66</u> 8.4	<u>1940-41</u> 4.3 <u>1966-67</u> 9.0	<u>1950-51</u> 6.6 <u>1967-68</u> 9.3	<u>1959-60</u> 5.2	<u>1963-64</u> 7.0
Norway	<u>1951-52</u> 38	<u>1954-55</u> 34	<u>1957-58</u> 28	<u>1960-61</u> 23	<u>1963-64</u> 20	<u>1964-65</u> 19
United States	<u>1920</u> 2.6 <u>1962</u> 10.0	<u>1930</u> 4.3 <u>1964</u> 10.4	<u>1940</u> 7.1	<u>1950</u> 11.0	<u>1955</u> 9.0	<u>1960</u> 9.9
Germany	<u>1952</u> 7.2*	<u>1959</u> 3.1*	<u>1966</u> (2-3)			
France	<u>1958-59</u> 9.8	<u>1966-67</u> 10.7				

* Estimates of G. Bengeser

In Table 3 an attempt is made to estimate such relative enrolments for selected countries, taking all postgraduate, third-cycle or promoted students. It appears that in Canada, France and the USA this percentage is 10%, in Norway and the UK it is substantially higher; but whereas it is still rising in the UK it has long been falling in Norway as the lower level degrees gain acceptance, e.g. cand. mag. Finally, in Germany it is extremely low and although the figures quoted (relating the number of students enrolled who have passed the first state or diploma examination to the total number of students) are not accurate, they are of the right magnitude. In fact, this is largely a consequence of the continuing probability in many disciplines of obtaining a doctorate without taking any earlier degree.(1)

(1) Thus, in 1964-65 the percentages of doctorates awarded to students who had obtained earlier degrees were: science 86%; technology, agriculture, medicine 100%; law 100%; social sciences 73%; arts/humanities/philosophy 4%.

Unfortunately there is little information on the relative costs of undergraduate and postgraduate education. In Canada, the Bladen Commission (1) estimated that on average graduate students cost 3-4 times as much per capita as undergraduate students. On a very simplistic estimate, therefore, if we take a cost factor of x 3, and 10% relative enrolment, we conclude that 25% of all higher education resources are being devoted to postgraduate education.

A second indicator is the transition ratio: that is, the proportion of students graduating who proceed to further education or training. By difference, this also indicates the proportion of students who take up employment. It is important, therefore, both as a rapid indicator of changing student choice - more rapid than the comparison of degrees awarded, which responds only with a significant time-lag - and an indicator of relative enrolments in years to come. It is important to point out that this is an indicator which varies substantially between fields in all countries. For example, in Germany transition ratios in chemistry, mechanical engineering and economics (1962) were approximately 0.87, 0.12, 0.13, respectively. It is therefore much less meaningful to compare ratios estimated over all fields than values in individual fields. In Table 4 we present transition ratios for the natural sciences.

TABLE 4
(ESTIMATED) TRANSITION RATIOS IN NATURAL SCIENCES (2)

	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1968</u>
United Kingdom	.26	.27	.30	.31	.30	.27
	<u>1953-54</u>	<u>1958-59</u>	<u>1960-61</u>	<u>1965-66</u>		
Norway	.93	.86	.54	.73		
	<u>1951-52</u>	<u>1952-53</u>	<u>1953-54</u>	<u>1956-57</u>	<u>1957-58</u>	<u>1959-60</u>
United States	(.18)	(.19)	(.21)	(.19)	(.19)	(.20)
	<u>1962-63</u>					
	(.23)					
	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>
Germany	(.54)	(.48)	(.45)	(.42)	(.40)	(.37)
			<u>1963-64</u>	<u>1964-65</u>	<u>1965-66</u>	<u>1966-67</u>
France			(.36)	(.38)	(.51)	(.46)

(Figures in brackets are estimates)

- (1) Association of Universities and Colleges of Canada: Commission on the Financing of Higher Education in Canada (Toronto 1965).
- (2) The ways in which these ratios were calculated are discussed in individual case studies.

IV. THE SOURCES OF GROWTH

An attempt to explain the growth of any part of the public education system must be in terms of three factors: the demands of students or pupils, the wishes of governments, and popular opinion as evinced by political choice. The first is relevant only at the levels of non-compulsory education. Obviously the three interact in a very complex way. In the first place, government policies must in some way reflect popular opinion in any democratic policy. The extent to which political expediency requires that policy reflects opinion depends not only upon the nature of the political system, but also upon the area of policy involved. It may be said that some areas of government policy are more "politicised" than others: that is, the level of popular interest in them is high, as is the force with which popular opinion is expressed either by pressure groups or in elections. For a variety of complex reasons education is in most countries a politicised issue of this kind; environmental deterioration is becoming another such issue in many countries; science policy, on the other hand, is very much less politicised. Now, within the general rubric "education" it is clear that popular concern varies with the level of education. In each country certain areas of educational policy are far more subject to political debate than are others. The availability of elementary education, for example, is not an issue in OECD countries; on the other hand, access to secondary education may be, and the organisation of secondary education frequently is. In some countries this is true of higher education. Universal secondary education in some countries, mass higher education in others, are potentially realisable social goals; it is this which endows them with their political character. This is not true of postgraduate education. Mass postgraduate education and equality of access to postgraduate education are not social objectives - let alone realisable ones - in any country, even the United States. Thus policies which have led to the rapid expansion of postgraduate education are in no real sense the result of political choice; in this it differs from the other levels of higher education. We are thus left with two relevant factors: student demands and government policy (formed in response to technocratic rather than popular influences). (1)

No voluntary level of education can grow unless students require it and either they or governments are prepared to make available the necessary resources. If student demand for a particular type of education exceeds the availability (for example, the Grandes Ecoles in France, medical education in the UK, or any higher education in Turkey), then either it may be redirected (students can be encouraged to study elsewhere or to re-apply the next year), or governments may find themselves unable to cope. On the other hand, if provision exceeds student demand (for example, scientific and technological education in the UK in the late 1960s) a situation may develop in which empty university places cannot be filled, with consequent under-utilisation of capital resources. Under such circumstances normative plans are of little value. In other words, the phenomenal growth of postgraduate education, especially in the natural sciences, must be a result both of students deciding that they want it, and both they and governments deciding to make the necessary investment. (The nature of this finance will be discussed in section V below. For the moment we may assume that, in scientific postgraduate education at least, the government is the major direct source of funds in all countries.)

(1) An exception must be made in respect of certain types of postgraduate professional training, e.g. medical training. In cases such as this the optimum supply of doctors or other classes of professional personnel may well be determined by political debate.

It is not possible to offer a complete explanation of this complex of decisions, both individual and governmental. Individual students and policy-makers alike are responding, whether consciously or unconsciously, to a whole range of pressures: economic, social and epistemological. However, only a few of the factors can be listed here which may have exercised a significant influence on students or on policy-makers, and no attempt will be made in any way to weight them vis-à-vis one another.

A. Student Choice

The best indicator of student choice would not be the real transition ratio between first and higher degree work but the percentage of graduates who would have liked to proceed to further study. In some countries the two are almost synonymous. In the natural sciences in Norway or Germany, for example, virtually all students receiving their cand. mag. or diploma degree would be able to stay in university if they would wish. Similarly, writing about graduate work in the USA in the late 1950s, Bernard Berelson concluded that "everybody who wants to get into graduate school does get in" (1). In the UK the situation is different. Donald Hutchings, in a sociological study of students' intentions on graduating, found that some 64% of science students and 37% of technology students would have liked to have gone on to do either doctorate or master's degree work (2); these figures may be compared with the 33% and 19%, respectively, who did so. Unfortunately, we do not have similar data over a time series, or for other countries. The importance of these figures, which relate to 1964-65, is as follows. If student preference, as expressed in answer to a questionnaire, is twice as great as real transition rate, a very considerable growth in transition rate is possible without there necessarily being any change in student choice; the process may be one of "taking up the slack".

In the USA, however, if all students who wish it may have postgraduate education (i.e. there really is a social demand determined expansion), we can conclude that student desire for such postgraduate training has increased. The same may be true of other countries, but we have no evidence. How do we explain this changing student preference? Unfortunately there is no single answer. Economists will explain it in terms of the rate-of-return on additional years of education, but whether this holds for non-scientific fields is doubtful. Berelson considers the choice of doctoral education as more of a drift than a choice: a negative choice. Other sociologists might write in terms of the social status of degrees: as bachelor degrees become more common the status accruing to their holders is inevitably reduced. Status considerations thus demand extra qualifications. Whilst we have no intention here of making a choice between these explanations, which are in any case determined by the intellectual terms of reference of those who put them forward, it is necessary to draw attention to the importance of status considerations for they can prove an important barrier to reform. The M.A. degree in the Philosophical Faculties in Germany (introduced as an alternative to the doctorate and the teaching qualification), the cand. mag. in Norway, and the doctorat de 3ème cycle in France, all suffer from lack of status in some or all disciplines.

-
- (1) B. Berelson: Graduate Education in the United States, (McGraw-Hill, 1960), page 144.
- (2) D. Hutchings: The Science Undergraduate (Oxford, 1967).

B. Specialisation of Knowledge

A second factor derives inevitably from the development of knowledge - particularly in the natural sciences. Derek Price has documented the exponential "growth of science" as expressed by the number of published papers (1). This exponential growth means that to reach the forefront of understanding within a field of study an increasing amount of learning is necessary. Certainly, some philosophers may argue that scientific progress is essentially a process of reduction - understanding reduces an increasing percentage of available information to a number of simple laws. This is not our concern here. The fact is that to the extent that a degree is regarded - whether by students, government officials or employers - as a complete preparation for a given technical job, to that extent there will be pressures for further study. In other words, the professional, or vocational, conception of higher education is necessarily subject to this process of inflation in qualifications. If, on the other hand, a degree is regarded as non-vocational, there is no reason why this factor need necessarily apply. An increasingly non-vocational first degree - such as the very much less specialised two years degree proposed in the UK by Professor Pippard (2) - could equally lead to increasing demand for further education and training. The determinant here must be the willingness of employers to provide on-the-job and in-career training and education.

C. The Demand for Scientists

This factor follows from the vocational nature of the Ph.D. and is specific to those countries in which the doctorate is regarded as preparation for a career as a professional scientist. Among higher degrees awarded in those countries dealt with in the case studies we might say that this is true of the American, British and Canadian Ph.D.s, and the French doctorat de spécialité. It is not true of the German doctorate or the Norwegian degree of cand. real. These degrees are not regarded either by students or employers as producing scientists. When however there is supposed to be such a relationship, then an increasing demand for scientists implies an increasing demand for Ph.D.s. How precisely this is translated into an increase in supply is of course a complex question. Again, one can only distinguish some of the relevant factors by which the two are linked. The most obvious factor is the price mechanism and the effect of shortage upon salaries. Another factor, and one acting on students and officials alike, is the influence of forecasts of need or of demand.

The relevance of forecasts

This is well illustrated by reference to the UK, although it is likely that consideration of the situation in other countries in which official manpower forecasts are published (e.g. France) could serve equally well. Throughout the 1960s, the Committee on Manpower Resources for Science and Technology published a series of reports on scientific manpower. Some of these were reports on triennial manpower surveys while others were ad hoc studies on manpower flows. The manpower surveys included estimates based upon the individual estimates of employers of their likely employment of scientists and engineers three years ahead. As Table 5 shows, the numbers are significantly overestimated.

-
- (1) Price, D. de S. See for example: Science Since Babylon, Little Science, Big Science.
- (2) Pippard, Professor A.B. See, for example, his Annex to the Swann Report (H.M.S.O., London 1968).

TABLE 5				
THE ESTIMATION OF INDUSTRIAL DEMAND (U.K.)				
	Estimates made in 1965 of 1968 employment of		Actual 1968 employment of	
	Scientists	Engineers	Scientists	Engineers
(All Manufacturing Industry)	38,111	86,892	36,595	74,681

Sources: Committee on Manpower Resource Report on the 1965 Triennial Manpower Survey (London 1966) page 14.
DES/Mintech Statistics of Science and Technology 1970 (London 1970) page 118.

Estimates in the case of scientists were thus 4% too high, and in the case of engineers 16% high. (Unfortunately no estimates were made relating specifically to Ph.D.s or to research manpower.) This poor estimation may be explained in terms of the natural difficulty faced by industrialists in assessing the growth of the economy as a whole or of individual sectors, or of their own particular share of the market. Nevertheless, it is possible that such estimates influence the development of the educational system. Similarly, one must consider the estimates of national "need" for scientists (1). Such estimates of need are made in a number of countries, and we may take as example the estimates of the "12 sages" in France, published in 1969. These estimates of the national need for research scientists till 1980 were of the "number of researchers necessary in order properly to use the funds available for research till 1980". (Table 6.)

TABLE 6
ESTIMATES OF NUMBER OF RESEARCHERS NEEDED IN FRANCE (1966-1980)
AS A FUNCTION OF THREE FINANCIAL HYPOTHESES (1)

Gerd (2) assumed for 1980	Scientists Needed and Full-time Equivalent			
		1966	1970	1980
High Hypothesis (35 x 10 ⁹ F)	Scientists	65,000	95,000	190,000
	f.t.e.	45,000	65,000	130,000
Medium Hypothesis (29 x 10 ⁹ F)	Scientists	65,000	90,000	150,000
	f.t.e.	45,000	62,000	120,000
Low Hypothesis (25 x 10 ⁹ F)	Scientists	65,000	85,000	115,000
	f.t.e.	45,000	60,000	80,000

Notes: (1) CCRST "Prospective de la Recherche Scientifique et Technique en France (III, Problèmes des Hommes et des Chercheurs)" Progrès Scientifique 128 (Paris 1969).

(2) Gross Expenditure on Research and Development.

- (1) "Demand is defined with respect to the community's ... willingness and ability to pay. Thus we may speak of a demand for more qualified teachers, meaning if more were available they would actually be offered teaching jobs.
Need is defined in relation to stated objectives of an organisation or a community ..." (UK Committee on Manpower Resources).

Taking account of demographic factors, the Comité Consultatif thus calculated that 110,000-150,000 new researchers would be needed between 1966 and 1980, of whom 90,000-130,000 would be natural scientists. Furthermore, they considered that at least two researchers in a group of six should have a doctorate. Yet, in 1966, only 961 third cycle doctorates and 689 state doctorates were awarded in natural science. Clearly, the implications are that a considerable expansion in the training of researchers is necessary.

Gannicott and Blaug, in a paper critical of the forecasting methods used in the UK by the Committee on Manpower Resources, accused the Committee of being a "lobby" for more science (1). In a sense this is true for it could be said to follow inevitably upon any estimate of national need for researchers, at a time when "progress" was regarded as being necessarily dependent upon the performance of research.

The market for scientists

The exact nature of Blaug's criticism of the UK Manpower Committee is of their failure to employ a concept of demand properly dependent upon economic factors. Demand, for the economist, is a quantity which is only meaningful when related to price. Logically speaking, a shortage resulting from disequilibrium between supply and demand should raise the price - in this case the salary - hence increasing the supply. We would not wish to dispute the logic of this relationship but the problems in its application to actual situations are acute.

In the USA a number of reports in the 1950s - by the President's Science Advisory Committee and others - of a shortage of scientists and engineers stimulated economists to attempt their own analysis using data indicative of the market situation. This is to say, the economic variables were introduced which all the need-related studies cited have ignored.

One such study was that by Arrow and Capron (2). These authors introduced the concept of a "dynamic shortage" to describe the rocketing market for scientists and engineers in the USA in the 1950s. The dynamic shortage resulted essentially from a rapidly rising demand, a sluggishly responding educational system, and a certain inelasticity between supply and demand. Although the situation is very different today, there is a lesson to be learned from this analysis. Because of the slow reaction of the market, and particularly the education system, it is mistaken to attempt too rigorously to modify this system in the light of current assessments of shortage or surplus. The slow reaction could easily result in continuously out-of-phase cyclical responses. The importance of this danger is now more widely recognised than it used to be: in Britain the Willinck Report is generally held up as an example of such a catastrophe (3).

-
- (1) K.G. Gannicott and M. Blaug: "Manpower Forecasting Since Robbins: A Science Lobby in Action" Higher Education Review, Autumn 1969 (London).
 - (2) K.J. Arrow and W.M. Capron: "Shortages and Salaries: The Engineer-Scientist Case in the US" (Reprinted in Penguin Economics of Education Vol. I Ed. Blaug).
 - (3) Ministry of Health: Report of the Committee to Consider the Future Numbers of Medical Practitioners and the Appropriate Intake of Medical Students (London 1957). This foresaw, mistakenly, a surplus of doctors and resulted in a catastrophic contraction of medical schools.

Even using economic data interpretations differ, and it would be unwise to look to the economists for an omniscient view of the manpower situation. Thus Blank and Stigler (1), analysing the salaries paid to engineers and scientists in the period prior to 1955, concluded that there was no shortage. Even for the period 1950-55, when many were claiming the existence of dire shortage, Blank and Stigler found that the very slight rise in wages precluded such a situation. Arrow and Capron (op.cit.), using their different definition of shortage, concluded that there was a shortage in the same period and rejected the argument of Blank and Stigler.

We are not using these examples to disprove the dependence of supply on price, indeed there is no doubt that such a relationship must exist. However, we do put it forward in order to demonstrate the complexity of the relationship in case this be considered as the source of a complete explanation of the growth of research training.

To summarise, there can be no doubt that science policy considerations have been exceedingly important in stimulating the growth of professionally-oriented postgraduate education in the natural sciences. They have undoubtedly operated both by stimulating student choice of such training and by stimulating governmental provision of resources.

Now that science is regarded as less of a panacea than once it was, and in real terms the funds available for research are beginning to fall, the situation must change. Precisely what effect such considerations have, not upon the provision of resources by governments where the effect is already apparent but upon student choice, remains a fascinating but as yet unanswerable question.

D. The Dynamics of the Higher Education System

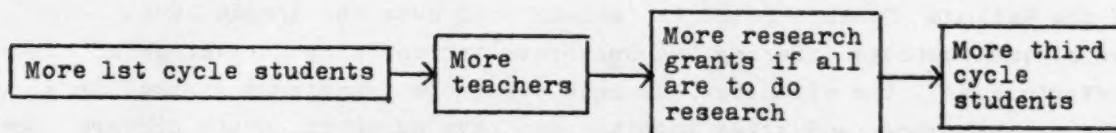
Postgraduate education is an essential feature of the higher education system, both by virtue of the contribution its research component makes to the university research effort and because it is an essential part of the preparation of future university teachers. Its development in recent years may therefore be attributed in part to the growth in university research and to the forecast needs for university teachers. A final contributory factor derives from the desire of many academic institutions to increase their status within the system.

Postgraduate education as an overhead on research

University research is carried out by three groups of graduate personnel: faculty members, fellows (or research assistants) and doctoral students. However, because in most countries (other than the US) students are numerically in a substantial majority, and because they devote a substantial proportion of their time to research (say, on average, 50%), students clearly carry out most of the actual work of research. In purely manpower terms - taking full-time equivalent manpower for each group - it is not difficult to show that in the UK and in Canada, for example, some two-thirds of all university research is done by postgraduate students. Over the past few years in many countries an increasing percentage of basic research has been entrusted to the university system. This has been to a very considerable extent the result of the growth in the project-support systems operated by national research councils (e.g. the D.F.G. in Germany, the N.R.C. in Canada, the N.S.F. in the USA, the C.N.R.S. in France). Grants of this kind have been used to finance an expansion in temporary research manpower at the postgraduate and postdoctoral

(1) D.M. Blank and G.J. Stigler: The Demand and Supply of Scientific Personnel (New York, 1957).

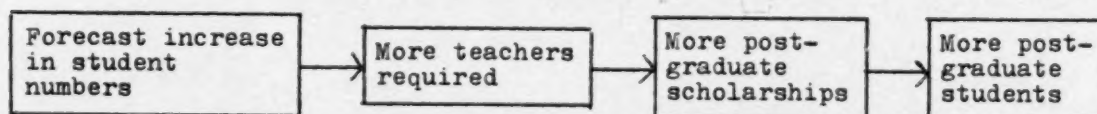
levels. We know, for example, that in Canada and the USA some 40% of doctoral students in the natural sciences are financed from funds provided as research grants to senior investigators. In Germany, a substantial proportion of those preparing their doctorates may be receiving funds from D.F.G. grants, and in France many students prepare their theses in laboratories of, or associated with, the C.N.R.S. In other words, some part of the growth of research education has been a result not of any conscious educational policy but an almost accidental side-effect of scientific expansion within the universities. One may describe the inexorable logic of the past few years:



This has, of course, been particularly the case in those countries in which university research has expanded most rapidly in response also to the desires of governments and industry to contract their basic research to universities.

The need for university teachers

In all countries in which it exists postgraduate education is regarded as an essential part of the training of university faculty members. (In those in which it does not, a period spent as a teaching or research assistant to a professor must serve instead.) In North America one cannot get a university job without a Ph.D.; in France the doctorat d'etat and in Germany Habilitation are prerequisites. In the USSR, too, the preparation of Aspirantura, after passing rather rigorous selection procedures, is the main mechanism for preparing university staff. Thus, a forecast expansion of the general higher education system, implying a need for more teachers, also implies a need for more trainee-teachers. Thus a second law of the dynamics of higher education growth may be described:



An example of a policy of this kind may be found in current higher education policy in the Federal Republic of Germany. Estimating that the current university population of 440,000 would more than double within ten years, the Federal Ministry concluded that a policy designed to secure a great increase in the number of university teachers was vital. A postgraduate student support scheme (Graduiertenprogramm) is to be put into effect during 1971. Students who have passed the promotion examinations qualifying for admission to doctoral study will be eligible; in 1971, 5,000 such awards are to be made and in each subsequent year 10,000 new ones. Thus, in 1974 there will be 20,000 two-year awards current. If this is compared with the 7,200 postgraduate doctorates awarded in 1966, it is clear that a considerable expansion is intended.

It is important to recognise that the time-lags in such a system are substantial. Calculation of needs, provision of scholarships, enrolments of more research students: these are but the beginning of the process. It may take as long as 5-7 years before the extra students graduate with their doctorates. An important secondary gain from the adequate support of research students from official sources may be a reduction in the time taken to obtain the degree, which would allow them to concentrate upon their studies.

Institutional change

The final "law" of higher educational dynamics could be said to be that describing the process by which academic institutions seek to improve what they regard as their status. In countries such as the UK, in which there is a formal distinction between university and non-university higher education, this process may involve the non-university sector attempting to acquire the attributes of the university sector. Among these attributes, postgraduate work figures notably. A similar process has existed for some time in the USA and manifests itself as an increasing tendency on the part of liberal arts colleges to award higher degrees. A recent report of the National Science Board (1) showed that over the decade 1955-56 to 1965-66 the number of institutions offering the doctorate increased by an average of 6.5 per annum. At the master's level, the situation has been even more dynamic as liberal arts colleges have taken up this work and other institutions have advanced to the doctoral level.

Although we have little information on this process of institutional change, it appears that it might be both natural and widespread (2). To that extent it, too, is an important contribution to the growth in postgraduate education. Clearly, this is a tendency which has important implications for those seeking to plan for rapid expansion in student numbers.

-
- (1) National Science Board: Graduate Education - Parameters for Public Policy (Washington 1969).
 - (2) Though not, perhaps, in Japan. The Preliminary Report of the Standing Committee on Graduate Education of the Association of National Universities addresses itself to the problem of encouraging research and postgraduate work in smaller universities - and not, as in some countries, of discouraging it.

V. SOME CURRENT ISSUES

A. How Should Postgraduate Study be Organised?

It has been pointed out above that in the natural sciences important tendencies exist for the creation of a professional Ph.D.-type degree in all countries which lack such a degree. However, in countries which have these degrees a dispute has arisen - whether explicitly or implicitly - over the relative importance to be attached to professional considerations on the one hand, and educational ones on the other. Professional considerations imply that the student is being trained to be a research scientist; in the natural sciences in Canada, the UK, the USA, this view has predominated. Countries with a non-professional doctorate have naturally tended to the opposite view. This is more than a philosophical question. In the first place it has important implications for the organisation of studies; in the second place it has implications for the desirability, or otherwise, of encouraging students to work for their higher degrees outside the university. In the third place it relates to how governments should most appropriately support postgraduate education financially - whether as an extension of higher education per se, or as an overhead on the performance of research. Finally, there is no doubt that it has implications for employment and manpower policy: the professional doctorate seems to carry with it the implication that recipients will be permitted a career in research. The first two questions are discussed here; questions of finance and of employment are dealt with in subsequent sections.

The issues raised relate particularly to postgraduate education and training in the pure sciences, and it is in relation to these subjects that problems are most acute. This does not mean that other fields are immune. It seems more than probable that if today's undergraduate-level explosion in the social sciences produces a postgraduate explosion tomorrow, then similar problems will arise there too.

The science policy-maker's conception of doctoral work is in most countries a professional one. He recognises that the students make a highly significant contribution to university research, but hitherto he has perhaps been less concerned with the educational contribution of this research. Thus, many current policies towards university research fail to pay due attention to its educational function. For example, many science policy-makers are convinced that large research groups are more research-productive than small ones. On the other hand, many academics feel that large-group research provides a less satisfactory educational milieu than does small group research. Policies of concentrating resources, creating large centres of excellence, are being implemented because of their potential benefits for the effective performance of research. Implications for the educational process are being given far less consideration.

"Many research units in Europe are too small to be viable, and concentration in fewer larger units would improve research output." Notable protagonists of this view are the Federal Republic of Germany and the United Kingdom. In the Federal Republic, the Wissenschaftsrat draws up a list of special research areas in which such a policy of concentration is to be applied. Special funds are made available by the D.F.G. (1), and the

(1) See D.F.G. Bericht (1969) pp. 72-79 (Bad Godesberg 1970).

procedure has been extended to a wide range of projects in the humanities, social sciences, natural and applied sciences. In Britain, the Science Research Council is beginning to implement a rather similar policy, and a recently published document sets out the basis of the policy (1). Certain areas "on the basis of a review of their special potential for advancing basic science, or their economic or community value" will receive special financial support ...

"A limited number of university departments will be given more favourable than average support to enable them to concentrate effort in selected areas; such departments will be selected on the basis of their leadership, past achievement, present expertise or other relevant factors (e.g. ability to co-operate with industry)."

Concentration of research education follows, but not as a result of specific consideration and without much thought being given to the educational implications of these policies.

This, among other dilemmas of postgraduate education policy, is a consequence of the rival claims of purely professional and more academic perspectives. Another such problem is the weight to be attached to formal instruction as part of research training/education. Countries differ substantially in present practice:

Canada	}	-	About half Ph.D. time spent in seminars, lectures, etc.
USA			
UK	-	-	Some compulsory course-work provided in the majority of chemistry and physics departments; not in biology.
Germany	-	-	Almost no instruction provided; none compulsory.
Norway	-	-	About 1/3rd time taken for <u>cand. real.</u> spent on advanced instruction. No formalisation of doctoral work.
France	-	-	The first year of work towards the third cycle doctorate spent entirely on advanced study leading to <u>D.E.A.</u>

One should add as a caveat the fact that the importance of formalising advanced study is universally recognised in policy-making and academic circles. In the UK, compulsory course-work is rapidly becoming more common; in Germany the absence of such work is regarded by government officials as a major deficiency in higher education provision. However, the danger also exists that formal requirements become excessive leaving no time for research. Although this does not seem to be the case in any OECD country, it is the case in the USSR, for example. Thus, students working on their Aspirantura are expected to spend two years principally on advanced study and on teaching, as a contribution to their pedagogical training. Increasingly, the third year, which is devoted to research, is found inadequate for a training in research, with consequent "drag out" (2).

(1) S.R.C. Selectivity and Concentration in Support of Research (London 1970).

(2) Reviews of National Science Policy: the USSR. OECD (Paris 1969), page 342.

Another problem in research education which is properly discussed here is the appropriateness of allowing, or encouraging, students to carry out their research in industrial or government laboratories. Many science policy-makers regard such possibilities as an important means of bringing academe and industry into closer rapport. It is argued that Ph.D.s who have done their postgraduate research in a "user" setting will be far more useful later. Custodians of academic standards argue that research done extra-murally may be of dubious educational value; industrial supervisors will scarcely be prepared - or able - to provide a real education. How common is research study of this kind?

- USA - Common in both government and industrial laboratories; universities have different rules.
- Germany - Common.
- UK - Not common; many universities permit research to be carried out in certain specified laboratories, usually under joint supervision. But, in addition, C.N.A.A. (1) Ph.D.s are available to industrial candidates.
- Canada - Rare; a very few universities permit study in certain government establishments.
- Norway - Common in N.T.N.F. institutes but unknown in industry.
- France - Common in C.N.R.S. laboratories.

(Although, as we have said, the encouragement of higher degree work outside the university is regarded as a method of improving university-industry and university-government relations, this is probably a mistake; it seems far more to result from good relations.)

The organisation of postgraduate study must be determined by its function. A professional doctorate in science may have to be organised entirely differently from a non-professional one in the humanities, with different course requirements and different control by the university in each case. Although a measure of formal educational instruction seems to be necessary in either case, the exact nature and extent of such instruction is a matter which cannot be left to chance. The twin dangers - that research training be accompanied by an inadequacy of instruction (as in many OECD countries) or by a surfeit (as in the USSR) - are both very real.

B. The Finance of Postgraduate Study

A question related to the previous one is that of the finance of postgraduate study by governments. Clearly, this is in principle a major instrument of control over postgraduate student numbers and output, if such control is desired. In many countries, the provision made by government authorities for the support of students studying for higher degrees has increased substantially in recent years. However, this increase has been

(1) Council for National Academic Awards. A self-governing body established in 1964 to award degrees to students outside the universities. The Council awards degrees at all levels, and in 1968-69 awarded about 60 Ph.D.s.

limited largely to the natural sciences (1), and to a large extent it has also been a by-product of the development of university research. The effect of this has been an expansion in postgraduate education - and hence in the production of research manpower - entirely divorced from any specific educational or manpower policy. This is a matter of considerable importance, especially in view of the violent fluctuations in research funds which are now possible - again without adequate consideration of the educational implications. A second important issue here is the question of grants versus loans in postgraduate student finance. To what extent is student finance a byproduct of research, students being considered, administratively, as cheap assistance? On the other hand, to what extent are they financed from funds intended for education? In practical terms, we may distinguish the following kinds of support funds provided by governments:

- (a) Studentships/scholarships/loans provided by ministries of education, or equivalent (2).
- (b) Fellowships/studentships provided by research councils.
- (c) (Research assistantships as part of research council grants to academic scientists (3))
(Research assistantships as part of government department contracts with academic scientists)

In the following table an attempt is made to break down government support of research students in various countries into three types, based upon the above classification. In the section following we attempt to point out the strengths and weaknesses implicit in the various systems.

-
- (1) Thus, of students in US doctoral-level departments, 43.7% of those in physical sciences were supported by the Federal Government, compared with 21.5% of those in the social sciences (1969). Graduate Student Support and Manpower Resources in Graduate Science Education N.S.F. 70-40, page 49. The figure for the humanities is certainly much lower.
 - (2) From this category we exclude students financed by universities from funds received by them from state ministries of education towards their normal running costs (i.e. indirect finance).
 - (3) By this term we include national bodies among whose major functions is the support of academic research: N.R.C. (Canada), C.N.R.S. (France), D.F.G. (Germany), N.A.V.F./N.T.N.F. (Norway), S.R.C. etc. (UK), N.S.F. (USA).

TABLE 7

APPROXIMATE EXTENT AND TYPE OF GOVERNMENT SUPPORT OF RESEARCH
STUDENTS IN THE SCIENCES 1968-69 (SELECTED COUNTRIES ONLY)

	PERCENTAGES			Total Research Student Enrolment (Sciences)
	From Educational Funds	From Studentship or Fellowship Programmes of Research Agencies	As Research Assistants	
Canada	0	30-35 (NRC)	15-20	5,500
France	25 (M.E.N.)	0	n.a.	18,000 /
Germany	(After 1971 about 50)	0	n.a.	3-4,000
Norway	50	10-15 (R.C.s)	10-15	500
UK	57	55 (R.C.s)	57	12,500 (full-time only)
USA*	5 (NDEA)	15	15	100,500

* Ph.D.-awarding departments only.

n.a. = not available

57 = $\pm$ 5 (central and local government)

/ = including doctorat d'Etat
(1966-67)

In Canada, the UK and the USA, very significant percentages of students are financed from government scientific sources, though in different ways.

In these countries the Ph.D. is essentially a professional degree. (In later paragraphs the finance of non-professional research degrees will be discussed.) Is it possible to point to specific advantages and disadvantages deriving from postgraduate student finance principally on the basis of a fellowship scheme(s) or principally as a by-product of contract research? In the first place, support by fellowships is plannable on the basis of scientific manpower need - if this is determinable. That is to say, the number of fellowships to be made available overall can be determined, as can the balance between fields of science. Of course, the total production of research scientists a number of years hence is not subject to tight control, partly because student support funds are also available from non-government sources. However, a system of support largely concentrated in a research council administered fellowship scheme appears to offer the greatest possibility for control of the output of researchers.

On the other hand, it has to be recognised that a large measure of research assistant support is due to the existence of particularly good university-user relations. In other words, although student finance in this way may make the limitations of Ph.D. output (if desired) difficult, it reflects a healthy research system. From the student's point of view it is likely to result in a protracted period of training. It seems likely that the US situation is about to change. The impact of the Mansfield amendment and of cuts in Federal R & D appropriations are likely to result in a rather greater concentration of student support. The N.S.F., for example, will to some extent make up for cuts elsewhere, and support from grants will increase at the expense of fellowship support.

The situations which have existed up to the present time in the USA and in the UK represent two approaches adopted by governments for the finance of doctoral-professional education in science and technology. The US system is pluralistic and reflects the close relationships obtaining between mission-oriented agencies and universities, as well as the vast need for research and researchers which America has experienced. The British system is more centralised and its scale reflects the desire of the British Government in recent years to restrict the output of Ph.D.-level science graduates. In countries where doctoral (or roughly equivalent) education is non-professional, funding procedures adopted by governments tend to be rather different. We may take as examples doctoral study in the Federal Republic of Germany and study for the degree of cand. real. in Norway.

In Germany, the Research Council (D.F.G.) has no mandate to finance students preparing their doctoral dissertations. Some are financed as research assistants on D.F.G. research grants, but it is a measure of the D.F.G.'s lack of interest in this matter that it has no statistics on the actual numbers. Before 1970 there had been no Federal schemes for the specific support of doctoral students, although a few promoted students must have received support under the "Honnef scheme" for the finance of university study in general (1). Also, some - possibly very many - are supported by Bund and Land funds as teaching assistants in universities. Again, we have no statistics on their number. In 1970 a new Federal policy was announced involving the provision by the Federal Government, through the universities, of a very large number of scholarships for postgraduate study (the Graduierten-Förderung programme).

(1) Perhaps the Volkswagen Foundation is the only body which has had a specific postgraduate policy - in particular of support for new interdisciplinary fields and for students to augment their first degrees by further study in a new field. See F. Gebhardt: Promotion und Stipendium (Göttingen 1967). But this is outside our discussion of government policies.

These scholarships are being made available from education rather than research funds, because forecasts show that there will be too few teachers in higher education for the one million students anticipated by 1980. In other words, the Federal Government is now concerned to train university teachers.

In Norway, the situation at the pre-cand. real. level is different again. The major mechanism used by the state for assisting students at this level is a system of loans. No distinction is made between finance of this and earlier levels of study. About 50% of students working for cand. real. receive loans; the rest largely support themselves. A programme of student support once operated by the Research Council (N.A.V.F.) has been reduced to an average of 25 students per annum, largely in medicine.

Germany and Norway thus represent two examples of government approaches to the finance of non-professional doctorates. In Germany a situation of laissez faire is now about to be drastically changed by large-scale Federal intervention, motivated by a presumed shortage of academic personnel. To some extent this implies a certain commitment to a more professionalised doctorate in Germany. In Norway, a system of loans is in existence (in contrast to the grants which will be made available in Germany) and there is no intention to upgrade the cand. real. degree. The loan system allows a true social demand approach: all who want a third cycle education can have it, at least in principle. Whether it is possible to make any normative judgements on the appropriateness of grants, or of loans, is a question much discussed by economists of education (1) and one which we will not enter into here. It may be, however, that the professionalisation of a given level of education has important implications for the decision as to which method of finance is appropriate. Advocates of a loan system of finance have sometimes argued that the post-graduate level is an appropriate place at which to begin the introduction of such a scheme - in the UK, for example. It is true that one of the main arguments adduced in favour of grants at the undergraduate level - that they are more favourable towards working-class participation - is not relevant here. On the other hand, there may be particularly important externalities attaching to professional postgraduate education which detract from the appropriateness of a market system.

C. Some Problems of Employment

The science Ph.D. in Canada, the UK and the USA is regarded as preparation for a career - at least initially - in research. Those who receive these degrees are rarely inclined to take other employment, and the prestige of the doctorate has resulted (in the UK in particular) in certain professions being deprived of the best students - the teaching profession, for example. Having received their Ph.D.s, science graduates in particular are inclined to expect a research post as their right. Many argue that the Ph.D. is a poor preparation for a career of any other sort, and at a time when funds for research are waning this is a matter of concern. Consider first the actual employment of those taking the professionalised Anglo-American Ph.D. What do they do? Data from the UK may be used to illustrate this point. In academic year 1968-69 higher degrees in pure science were

(1) See e.g. Harris, S.E.: Higher Education: Resources and Finance (McGraw-Hill 1962) Chaps. 17-22.

Peacock, A.T. and Wiseman, J.: Education for Democrats (Institute of Economic Affairs, London 1964).

Blaug, M.: Introduction to the Economics of Education (London, 1970) Chapter 10.

awarded to 3,716 men (65% doctorates) and 414 women (55% doctorates) (1). Their first employment was as follows:

TABLE 8
FIRST EMPLOYMENT OF HIGHER DEGREE
GRADUATES IN SCIENCE (UK, 1969)

No. of Degrees Awarded (a)	Further Scientific Education or Post- Doctoral Fellowship (b)	In Employment in UK		
		Total (c)	Scientific Research (d)	Other R&D- type Activities (e)
All Science				
Men 3,716	925	1,306	583	210
Women 414	86	145	59	21
Total 4,130	1,011	1,451	642	231
Chemistry				
1,235	379	463	269	69
Physics				
795	155	274	133	49

In other words, approximately one-quarter of all higher degree graduates carry on with their research studies in universities. Approximately one-third enter employment in the UK, half of whom engage in research. Therefore only one-sixth of all higher degree graduates carry out scientific research in productive employment. It is considerations such as these which have led recent UK reports on scientific manpower to recommend that a decreasing percentage of those graduating should proceed to research training (2). Current policy - of the Science Research Council, for instance - is to attempt to restrict this percentage.

In neither Britain nor America is there evidence of true Ph.D. unemployment at the time of graduation. In the UK, UGC statistics show that the percentage of higher degree graduates still seeking permanent employment on 31st December of their year of graduation is minute. In 1969, for example, 46/3,716 (1.2%) of men and 8/414 (2%) of women higher degree graduates in pure science were unemployed. In the USA a study by the National Research Council (3) showed that 1.1% of 1969 Ph.D.s were unemployed - with no significant differences between fields of science. A further 0.7% were in employment "irrelevant to the individual's disciplinary competence". There is very strong evidence, however, that in both of these countries, and in Canada, the employment situation is far from satisfactory

- (1) First Employment. Subsequent data relate to all higher degree graduates. Separate figures for Ph.D. holders were not available.
- (2) C.M.R.: The Flow into Employment of Scientists, Engineers and Technologists (Cmd. 3760, H.M.S.O. 1968).
- (3) L.R. Harmon et.al.: "Employment Status of Recent Recipients of the Doctorate", Science, 22nd May 1970, page 930.

for newly trained professional scientists and for scientists in general. In the first place, heads of scientific departments have indicated, both in UK and USA, that students receiving Ph.D.s are finding it very much harder to obtain suitable employment than was the case a few years ago. In the second place it seems likely that many are taking posts which until recently might have been filled by non-Ph.D.s. Of those who do obtain research posts, a very great number are taking post-doctoral appointments. This phenomenon is worthy of particular consideration.

Non-Economic Employment (or concealed unemployment)

We are using this term to describe an employment situation which has developed over the past few years. "Non-economic employment" is the employment of large numbers of doctoral graduates in temporary research fellowships, which does not represent a true growth in demand. There is an appearance of full employment of graduates trained in research (i.e. no unemployment), but this tends to be no more than a postponement of the crisis for there is generally no equivalent growth in permanent posts. Furthermore, at the postdoctoral level the possibilities of redeployment are further reduced. This situation has been developing over the past few years, although we do not know in how many countries. For the USA, it is described by the following figures:

TABLE 9

PERCENTAGE OF Ph.D. RECIPIENTS IN PURE, APPLIED,
AND SOCIAL SCIENCES TAKING TEMPORARY FELLOWSHIPS (USA)

	1958	1960	1965	1966	1967	1968	1969
All Sciences	4.5	9.6	14.9	14.9	15.7	15.4	19.3
Chemistry	(6.5)	(15.5)	(27.8)	(26.6)	(29.1)	(28.8)	(32.9)

Source: L.R. Harmon et.al.: "Employment Status of Recent Recipients of the Doctorate", *Science*, 22nd May 1970, page 930.

The development may be seen in the figures for "all sciences", but it is more specific to the basic sciences: physics and biology show a trend similar to chemistry. There is no doubt of the importance of these unestablished fellows to the performance of academic research, and for newly developing disciplines their lack is often a major barrier to development. However, the inflation of demand by such posts must not be taken as a growth in real demand. The number of fellowships is almost certainly subject to far more violent fluctuation than any real demand for skills of this kind would be. It may be that this inflation inhibits the true equilibration of supply and demand.

We may say that all of the countries considered here in which professional doctorates are awarded - that is, in which the training of research scientists is essentially the prerogative of the universities - are suffering crises in the employment of their recipients. This is true of Canada, the UK and the USA. Although to some extent this is the result of coincidence, to some extent it is also surely the result of the expectations of a research career which accompany the receipt of the Ph.D. The words of the Swann Committee are of interest:

"... we think, it is almost certain that the prestige attached to the Ph.D. course, and the prospect of the title 'doctor', does draw some persons into academic research who might otherwise, with advantage, go elsewhere; and to this extent we think it is unfortunate that a

doctorate, with all that the title implies in terms of status in the academic world (and to some extent outside that world), should be obtainable in only one way, namely, by three years of pure research, normally single-handed, and normally within a university." (1)

If academic posts are lacking, clearly Ph.D.s are finding alternative employment; the small unemployment figures demonstrate that. But how much value is their Ph.D. when they enter, for example, industrial employment? Clearly this is a problem which has preoccupied many science policy-makers, perhaps most especially in the UK and Canada.

Industrial opinion is far from unanimous. Many industrialists express themselves as satisfied with the Ph.D.s they employ. This may be, and in some cases almost certainly is, no more than a consequence of the Ph.D. as an indicator of quality. Industrialists want the best people - and which employer does not? For them, possession of a Ph.D. is a useful indicator of quality, if nothing else. In other cases, satisfaction on the part of industrialist employers is undoubtedly a consequence of a more fundamental rapport. In these cases, it must surely derive from the effective integration of the research activity - which is what Ph.D.s are trained to conduct - into the firm's production process. On the other hand, many industrialists are clearly dissatisfied with the science and technology Ph.D.s they employ. They argue that holders of the degrees are too narrow in their interests and unable to communicate outside the laboratory. It then follows that the Ph.D. should be made more relevant (for example, the research topics chosen should more closely match industrial problems), and they should be less oriented towards fundamental science. There is a danger in too unthinking an acceptance of this argument (2). What if the maladaptation is principally a consequence of industry's temporary inability to integrate effectively its R & D and production processes? Is a levelling down of the educational process appropriate then? The experience of the really effective firms in research-intensive industries suggests that this may indeed be the situation (3). It is important to recognise that control of the number of Ph.D.s, and of the nature of the degree, is independently possible. To change two parameters in the known state of a system may produce a totally unknown state.

Other countries have not been faced with these problems in so acute a form, and to some extent this may be an advantage of an unprofessionalised degree system. Doctoral education in the USA, in Canada and in the UK has undoubtedly acquired a momentum of its own and is perhaps less than sensitive to the general needs of society. The critical test may be the response of the higher education system to the decreasing demand (and finance) for doctoral education, especially in the USA. Will the demand for doctoral education respond to the falling needs of society now, or will its internal dynamics prove the more powerful?

(1) Committee on Manpower Resources: The Flow into Employment of Scientists, Engineers and Technologists (London 1968), paragraph 128.

(2) Or of a related argument from current rates-of-return. It may be (for example, in the UK) that current rates-of-return to the individual on doctoral education are low, as they are reflected in salary differentials. If so, this could be a consequence of temporary industrial malaise.

(3) A similar conclusion has been reached in a recent sociological study of research chemists in British industry ... "industrial research offers only restricted opportunities for the challenging use of skills". S. Cotgrave & S. Box Science, Industry and Society, Chapter V (London 1970).

D. Postgraduate Study Abroad

Among OECD countries there are some which have traditionally educated large numbers of foreign students. In some of these countries foreign students form a considerable proportion of the total enrolment (e.g. Switzerland 26.3%, Austria 19.4%). In others, although the proportions may be less, the total enrolments of foreign students are themselves large (e.g. USA 82,709, France 28,354, Germany 22,524 (1)). Equally, there are countries among OECD Members which have traditionally sent large numbers of students abroad for their education. Among these are Norway, Greece and Turkey.

On the whole - although there are exceptions - this educational mobility is more important in percentage terms at the postgraduate than at the undergraduate level. For example, in the USA the proportion of foreigners in total enrolments was 1.7%, among graduate students about 10%. A second important point is that whereas mobility at the undergraduate level may be falling off as educational systems expand, at the postgraduate level it appears to be continuously growing. Thirdly, countries which have very large R & D expenditures tend to have proportionately more students in the natural sciences than in the humanities or social sciences. This is true, for example, of the UK and the USA (2). The fact that it is not true of France may be a reflection either of the prestige of French non-scientific culture or of the relatively recent development in science expenditure. These three factors are illustrated in Table XI, which relates to Canada, France, the UK and the USA. Clearly, a very considerable proportion of the resources devoted to postgraduate education in science by some countries (notably Canada and the UK in the applied sciences) is devoted to foreign students. This interdependence has obvious implications for the possibility of any effective manpower planning at this level, both for "sending" and "receiving" countries.

A rather different pattern is found for countries such as Austria and Switzerland which, partly for geographic and cultural reasons, have traditionally educated large numbers of foreign students but not principally in the sciences nor principally at the postgraduate level. The following data relating to Switzerland are relevant:

TABLE 10
PERCENTAGE OF DEGREES AWARDED TO NON-SWISS STUDENTS

		<u>1950-51</u>	<u>1960-61</u>	<u>1966-67</u>
1st Degree Level	Science/ technology	17.0	19.7	22.5
	All subjects	24.5	27.7	26.5
Doctorates	Science/ technology	16.6	20.6	24.9
	All subjects	13.6	23.6	29.2

Source: Development of Higher Education 1950-1967, Statistical Survey. OECD (Paris 1970). Comparisons are a little confused by the retaining of the doctorate as a first degree in the humanities by German-language universities, but the general thesis remains.

(1) Development of Higher Education 1950-1967, Analytical Report (OECD 1971), Table A-3.

(2) Thus, the 10% foreigners among all graduate students in US universities may be contrasted with 20% foreign students in science doctorate departments in 1969 (17% in 1967).

TABLE 11
% ENROLMENTS OF FOREIGN STUDENTS BY LEVELS
(AND SUBJECTS) OF STUDY

	All Levels	Postgraduate Level
CANADA	5.5 (1)	48.5 (2)
FRANCE (1966-67) (3)		
Science	5.4	10.7
Medicine & pharmacy	8.1	8.5
Law	5.6	20.4
Humanities	6.7	30.6
	6.4	13.7
UNITED KINGDOM (4)		
Pure science	2.0	18.1
Applied/medical sciences	7.1	39.3
Social sciences	3.7	31.5
Education	31.0	7.5
Humanities/arts	2.8	34.0
	4.2	25.4
UNITED STATES		
1950-51	1960-61	1965-66 (1)
1.3	1.5	1.7
	1967	1968
Science only	16.9	18.3
All departments		20.0
		[10]

Notes:

- (1) 1964-65 Source: Development of Higher Education 1950-1967, Analytical Report. OECD (Paris 1971).
- (2) 1967-68: Science only. Source: Profile of Graduate Students enrolled for the Doctorate in Science. (N.R.C., Ottawa 1968) Tables 14, 15.
- (3) Source: Annex B to this report.
- (4) Source: Overseas Students in Britain 1967-68 and Statistics of Education (VI, 1967).
- (5) 2,338 science doctorate departments only. Source: Graduate Student Support & Manpower Resources in Graduate Science Education (N.S.F. 70-40).

Norway is an example of an "exporting" country. The percentage of all Norwegians receiving their higher education abroad has fallen from 30% of all registered in 1956-57 to 11% in 1969-70. At the postgraduate level it remains very important and indeed is encouraged by the fellowship schemes of the Council for Scientific and Industrial Research. The problem posed by reliance upon this means of education is that of non-return. For less-developed countries there is the additional difficulty that returnees may have interests entirely unrelated to the needs of the country.

There is no doubt that for a large number of OECD countries this must be an important element of any policy for postgraduate education. In particular, the extent of this educational mobility - particularly in the natural sciences - renders difficult and uncertain both the planning of the scale of postgraduate education and the comparison of university output with forecasts of manpower needs. Of course, this conclusion in no way detracts from the important gains - for example in international understanding - which derive from educational and scientific interchange.

E. The Planning of Postgraduate Education

Among the countries studied in detail for the purpose of this report, only the UK has made a conscious effort, as a matter of policy, to control the output of higher degree holders. In particular, there has long been an implicit belief that more Ph.D.s are being produced than can profitably be absorbed by the economy. By contrast, as we have shown, French plans have indicated a greatly expanding need for researchers, and in Germany an expanding need for university teachers has been indicated. In both of these countries, therefore, expansion of high-level research training is clearly to be encouraged. In Germany the implication is that although the doctorate is not regarded as a professional training in research, it is increasingly coming to be accepted as in some way linked with preparation for a university career; a trend, moreover, which can only be emphasised by the strong movement to remove the traditional gateway to the academic profession - Habilitation. In Norway the situation is different because the cand. real., although involving a substantial element of research, is far from a vocational degree: originally a preparation for secondary school teaching, it is now accepted as a "proper" education for as many students as wish it. So there can be no normative plans specifically of the output of cand. real. graduates. Similarly, in the USA, although for very different reasons, there have hitherto been no attempts to control the output of Ph.D.s. The absorptive capacity of the economy for Ph.D.s, stimulated by the Federal need for research, has been vast. It is probably true, however, that in many countries policy-makers are increasingly concerned - although reasons may differ from country to country - with the regulation of the supply of certain categories of manpower. Scientific research manpower may be one such category, and those educated to the Ph.D. or equivalent level are a most important sub-category.

There are important difficulties, both conceptual and practical, inherent in such an exercise. The conceptual difficulties may be summarised as follows:

- (i) supply is hard to assess both because of the inexact correlation with the output of the educational system and because of the uncertainty of student career choice;
- (ii) supply and demand are not independent variables, they interact through the labour market;
- (iii) there are dangers in the attempt to regulate the number of places in the light of assessment of the current situation, however accurate the assessment;

- (iv) it is not clear whether need or demand should be related to supply; most national forecasts have used the former, but it is a vague concept;
- (v) there are ideological objections to basing educational provision upon manpower plans; for many countries social demand is the essential determinant.

There are also practical obstacles which need be faced. The first derives from the existence of multiple foci of power in the finance of research training. This is true even when such training is concentrated in the universities. Both funds and consequently plans derive from educational agencies on the one hand and from research agencies on the other. Disciplines in which research grants are few and small (e.g. the humanities, languages, arts) are scarcely faced with this problem, but in the natural sciences educational agencies and research agencies are rival foci of power. It is impossible to discuss the planning of research education in the natural sciences without recognising the significance of this division of responsibility. In centrally-organised countries, inter-ministerial co-ordinating machinery can be established easily enough, at least in principle. There is, however, no guarantee that objectives can be reconciled. The commitment to educate the nation's youth to the limits of its desire for education, and the commitment to the equilibration of supply and demand for research manpower, may be fundamentally in opposition. The planning problems faced by federally-organised countries are very much greater. In almost all such Member countries higher education is the jealously guarded prerogative of state, canton, province or Land. This is true, for example, of the USA, Switzerland, Canada and Germany. In these countries the majority of universities are traditionally financed by the regions in which they are situated. Additional finance from federal authorities tends to be a recent incursion into local autonomy which may be more or less resented. Many countries of this kind have no ministry of education at the federal level. The extent to which purely educational funds can be given to universities by the federal government tends to be a matter of internal politics. By contrast, of course, research in science has everywhere become a major responsibility of central governments. Universities have come to rely upon central government for research grants for specific projects ("of timeliness and promise") to supplement funds for research from general university funds. Almost all OECD countries have a central agency - a research council - to provide such funds to university researchers. The dependence of universities upon such funds is increasing, and the effects of these funds upon universities are profound (1).

The establishment of effective co-ordinating machinery between a central research agency and autonomous state educational agencies is clearly a difficult matter. The Wissenschaftsrat (Science Council) is a West German organism with this objective, made up of representatives of the Land Education Ministries, the Federal Government, and the scientific community. Such a body can only be advisory, and the undoubtedly high status of the W.R.

(1) See, for example:

Orlans, H.: The Effects of Federal Programs on Higher Education (Washington: Brookings Institution 1965).

Blume, S.S.: "Research Support in British Universities - the Shifting Balance of Multiple and Unitary Sources" Minerva VII (4) (1969).

and its influence depend upon the quality of its analyses rather than upon executive authority. Because of differences in wealth, political climate and population, states frequently have different objectives in higher education and the reconciliation of all these views, and a central "science view" (essential if research education is to be planned), may be virtually impossible. The W.R. itself considers that the degree of implementation of, for example, its 1966 report on the reorganisation of university studies has been slight.

How possible is effective planning? Educational planning is always difficult: government planners never have control of all the factors influencing the educational system. This is as true at the postgraduate level as at other levels of the educational system because of the multiplicity of sources of funds. We have already shown how the availability of funds for student stipends from both educational and research sources makes government planning difficult. But co-ordination is possible. In actual fact, very many research students in the majority of large Member countries are supported from funds over which government planners have no control. In the UK, for example, some 35% of British Ph.D. students in science and engineering are financed from non-government sources; in the USA over 60% of graduate students in science and engineering are financed from non-Federal sources. Industry is one such source of funds: over 1,300 students working for Ph.D.s in science and technology in the UK were financed from industrial funds in 1969 (1). Many science policy-makers are concerned to encourage industrial subvention of academic research. It is rarely realised that such increased subvention makes it far more difficult for the output of Ph.D.s to be restricted. A multiplicity of sources of research funds has both values and disadvantages. One can hypothesise that the healthier university research is, the better its links with industry, the more impossible planning of research education becomes. The same argument can be applied to government support of academic research: it is possible that support from a variety of user-sources offers less scope for co-ordination or control than support from a single agency. It could be argued that if this education does not constitute a direct cost to the public purse, it need not concern governments. There is still a problem, however, if it is accepted that the possibilities of redeployment of manpower are reduced with increasing age and specialisation. In other words, Ph.D.s are less likely to accept such employment as the market offers than are those with lower qualifications.

In the non-scientific disciplines the problem is less acute. The capital provision which needs to be made for additional postgraduate students is less than it is in the sciences and there are no rival foci of power. Furthermore, expansion has been less rapid and the interaction with the economy is less direct. However, there is a clear interaction with the educational system and any shortages of secondary school or higher education teachers may give rise to a need for expansion of one or other category of postgraduate education. This is as likely to be in philosophy or languages as in chemistry. Again, not only is the problem less acute than in science, but teaching at the secondary level is a much more acceptable and usual career than it is for a science Ph.D.

(1) This represents over 11% of the total but conceals wide variations between fields. Thus, the percentage was 17.4% in chemistry and only 4.8% in biology.

F. Some Final Considerations

In the previous sections the attempt was made to deal with those issues with which any policy towards postgraduate education must be concerned. Although they were discussed with particular reference to the problems of pure sciences, they are not specific to these disciplines. It is rather that the pressures towards the formulation of a specific policy towards postgraduate education are strongest there. Secondly, they dealt in some instances more specifically with the problem of countries in which the doctorate is professionalised (see section II) than of those countries in which it is not. Again, the tendency towards the introduction of such a professionalised degree, akin to the Ph.D., is strong in those countries we have looked at which presently lack it. These issues do, therefore, have some general relevance.

The essential problems of postgraduate education are many, especially in those countries in which an uneasy equilibrium exists between a traditional education system and a modern system of science. Frequently what passes for postgraduate education is the result of "pouring old wine into new bottles": the label is scarcely indicative of the contents. This is particularly apparent when a traditionally long degree course has been divided into two cycles, such that one cycle becomes "postgraduate". The inevitable problem seems to follow of the lack of status of the newly created intermediate degree. The M.A. in Germany, the cand. mag. in Norway, the Licence in German-Switzerland, none have yet been able to lose the "staging post" image. Clearly this is a matter of importance for countries in which such a division remains a means of creating a postgraduate cycle of study. A rather different status problem appears in France, although again deriving from the juxtaposition of old and new. This is the preference of agrégés over holders of the third cycle doctorates for junior university posts in Faculties of Law and Letters. If the doctorate in arts and social science disciplines has any relevance it is to the academic career, for a preparation in the research methods of these disciplines is surely an essential aspect of the training of future professors. Again, the new and old coexist to the disadvantage of the former.

A postgraduate cycle formed by addition to the traditional system, rather than by division, seems not to have suffered from this status problem. One can instance the bachelor's and master's and doctorate cycles of American or British education. But it would not be true to say that this system is bereft of all status problems. A major problem in the USA in particular is the diminished status of the master's degree. To a considerable extent this has derived on the one hand from the ease of admission to doctoral study, on the other to the use of the degree both as an automatic staging post on the route to the doctorate and as compensation for those who fail to earn the doctorate. There can be no doubt that the effects of this misuse are unfortunate. The retention of a fairly general, educational, non-vocational first degree necessitates the availability of a 1-2 year professional master's-type degree. Increasingly this may have to be an employment-oriented true alternative to the doctorate and not a stage towards it. A significant student demand for postgraduate education can most profitably be channelled into master's courses at a time when the demands of society for research personnel are falling. The value of such 1-2 year professional postgraduate alternatives is increasingly being recognised; policy in the UK, for example, is designed increasingly to divert students towards them. The introduction of the D.E.A. (and A.E.A.) in France as part of the requirements for the specialist (and research/academic-oriented) third cycle doctorate is a step in the direction we are advocating. The professionalisation of the D.E.A. would be a second step: that is, a D.E.A. could be offered as an employment-oriented professional qualification as well as a test of suitability to carry out research.

A number of OECD countries, although their universities award degrees which involve a significant research component, have no professional research degrees akin to the Ph.D. There are powerful demands from pure scientists (with their international orientation) for the introduction of such degrees. This is generally regarded as requiring a formalisation of the research component of the degree: that is, the introduction of relevant and systematic guidance for the research student. In Germany, the Wissenschaftsrat has long been arguing for a formalisation of the research component of the degree - in other words, the introduction of relevant and systematic guidance for the research student. This seems to be a necessary part of a degree oriented towards the training of research workers, and this is a degree which seems to be universally demanded. However, a word of caution seems appropriate. North American and British experience seems to indicate that such a degree system can easily acquire a momentum of its own. The direct production of research workers by the education system must be monitored in the light of science policy considerations; controls on the extent of such production are essential. Such controls must be tied in with some estimate of the need for researchers and the need for university teachers. Equally, however, it is perhaps appropriate for countries in which the professional research degree exists to bear in mind that there surely remains an obligation to educate as well as to train.

However, once again it should be emphasised that research education of this kind is only one form of postgraduate education; it must be regarded as one among other possibilities. As the whole concept of science policy changes, it seems that these other possibilities will be of growing national importance.

RAPPORT GENERAL

RAPPORT GENERAL

TABLE DES MATIERES

	<u>Page</u>
<u>RESUME</u>	50
I. <u>INTRODUCTION</u>	54
II. <u>NATURE DES ETUDES UNIVERSITAIRES DE TROISIEME CYCLE</u>	56
III. <u>ASPECT STATISTIQUE DU DEVELOPPEMENT DES ETUDES UNIVERSITAIRES DE TROISIEME CYCLE</u>	60
IV. <u>ORIGINES DE L'EXPANSION</u>	66
A. Choix des étudiants	67
B. Spécialisation des connaissances	69
C. La demande de chercheurs	69
D. La dynamique du système de l'enseignement supérieur	74
V. <u>QUELQUES QUESTIONS D'ACTUALITE</u>	77
A. Comment les études universitaires de 3ème cycle devraient-elles être organisées ?	77
B. Le financement des études universitaires de 3ème cycle	81
C. Quelques problèmes de l'emploi	85
D. Les études universitaires de 3ème cycle à l'étranger	89
E. La planification des études universitaires de 3ème cycle	92
F. Quelques considérations finales	95

RESUME

Les "études universitaires de troisième cycle" sont d'une importance croissante pour les responsables de la politique de l'enseignement, qu'il s'agisse de l'enseignement supérieur ou de la recherche, cette expression cependant est à la fois complexe et ambiguë. Dans un but de simplification on a ramené à trois les types d'études universitaires de troisième cycle considérés dans le présent document : la formation professionnelle (médecine ou droit par exemple), l'enseignement approfondi de la discipline dans laquelle l'étudiant a obtenu son premier diplôme (pour l'obtention d'un Master's Degree par exemple), et enfin la formation des chercheurs. C'est ce dernier point qui fait l'objet de ce rapport ; il s'agit précisément des études consécutives à l'obtention d'un diplôme de niveau universitaire, conduisant généralement au doctorat et comprenant au moins un élément de recherche. Une attention particulière a également été portée aux études scientifiques. Bien que certains pays de l'OCDE n'aient pas encore créé de troisième cycle d'études universitaires dans le cadre de l'enseignement supérieur, dans la plupart des pays où ce cycle existe sa croissance a été extrêmement rapide, beaucoup plus que celle des cycles qui le précèdent. En effet, il est relativement courant que le nombre de diplômes supérieurs délivrés annuellement ait doublé depuis cinq à six ans.

Le développement de l'enseignement supérieur dépend des ressources fournies conjointement par les gouvernements et par les étudiants (à titre volontaire et individuel). Au niveau des études universitaires de troisième cycle, il est particulièrement important que les gouvernements affectent des fonds à la recherche. L'expansion de l'enseignement de troisième cycle, et plus particulièrement de l'enseignement préparatoire au doctorat, peut être attribuée à l'interaction complexe de facteurs très divers : évolution du choix des étudiants, développement des connaissances, demande accrue de chercheurs et enfin expansion (et dynamique interne) du système d'enseignement supérieur lui-même.

Toute politique relative aux études supérieures de troisième cycle orientées vers la recherche doit tenir compte de problèmes essentiels dont certains sont examinés dans la deuxième partie de ce rapport ; ils peuvent être résumés sous trois titres :

(a) Problèmes d'organisation et de financement

L'étude des systèmes individuels d'enseignement supérieur fait ressortir d'importantes différences entre les pays, dans les domaines suivants :

- (i) La concentration des travaux au niveau du doctorat dans un nombre limité d'institutions par rapport à celui des établissements dispensant un enseignement préparatoire au premier diplôme, et de plus en plus fréquemment un certain degré de spécialisation institutionnelle.
- (ii) La possibilité, pour les étudiants de haut niveau, d'obtenir un doctorat sanctionnant des travaux effectués dans le cadre de leurs activités professionnelles. Cette autorisation peut soit leur être systématiquement refusée, soit leur être accordée s'ils travaillent dans certains départements ou laboratoires gouvernementaux ou encore leur être donnée sans grande difficulté. En outre, le degré de surveillance exercé par les établissements d'enseignement sur leurs étudiants effectuant des recherches à l'extérieur diffère très sensiblement. Enfin, les

étudiants peuvent être rattachés à une université, ou bien un organisme spécialisé délivrant des diplômes (tels que le C.N.A.A. au Royaume-Uni) peut être créé à cette fin.

(iii) La composante magistrale de l'enseignement fondé sur la recherche peut être pratiquement nulle dans certaines disciplines et dans certains pays et par contre comporter jusqu'à deux années d'études dans d'autres. Ces études peuvent être utilisées soit pour préparer l'étudiant à des recherches spécialisées, soit pour compléter des travaux spécialisés au moyen d'un enseignement des méthodes pédagogiques (comme en U.R.S.S. par exemple). Si l'enseignement magistral est insuffisant, l'étudiant risque de s'engager dans sa carrière de chercheur en y étant médiocrement préparé, s'il prend trop d'importance la durée totale des études risque de se prolonger de manière excessive.

(iv) Les méthodes de financement varient très sensiblement. L'accent peut être mis sur le financement émanant de sources principalement scientifiques (tels les Conseils de la Recherche) ou d'autres sources, tels les ministères de l'éducation ou les fondations. Les sources scientifiques qui financent les étudiants se préparant à la recherche peuvent le faire au moyen soit de subventions pour la recherche, soit de bourses de perfectionnement créées par les Conseils de la Recherche, bien qu'en général ces deux modes de financement se complètent. Si l'accent est mis de manière excessive sur l'une ou l'autre de ces méthodes, de sérieux problèmes peuvent s'ensuivre. Dans d'autres pays, il se peut que les étudiants effectuant des recherches soient principalement financés à partir de fonds spécifiquement consacrés à l'enseignement, sous la forme soit de subventions soit de prêts. Il a été suggéré que le niveau des études universitaires de troisième cycle se prête particulièrement bien à l'introduction d'un système de financement par prêts. Mais, ici encore, chacune de ces procédures présente des avantages et des inconvénients assez bien connus.

Il est suggéré, dans le rapport, que les pays donneront la préférence explicitement ou implicitement à l'une ou l'autre de ces positions, selon leur conception des études universitaires de troisième cycle : professionnelles (en vue d'une formation aux carrières de chercheurs) ou didactiques (recherche en tant que méthode didactique). Une politique cohérente exige que cette opinion soit explicitement formulée et que les décisions sur les questions soulevées plus haut en dérivent.

(b) L'emploi des titulaires du doctorat

Le doctorat à caractère professionnel de l'Amérique du Nord et du Royaume-Uni (le Ph. D) a de tout temps été considéré comme une garantie virtuelle d'accès à une carrière de chercheur, de préférence au sein du système universitaire. A une époque où les systèmes d'enseignement supérieur sont en large expansion et où la demande de personnel de recherche est élevée, cette conception ne crée pas de problème. Lorsque les systèmes universitaires restent stationnaires (que ce soit pour des raisons démographiques ou financières) ou que la demande de chercheurs est en baisse, des difficultés peuvent surgir. Bien que rien - ou presque - ne semble annoncer une stabilisation de l'effectif des étudiants, les taux de croissance des

dépenses de recherche et de développement, qui récemment encore étaient élevés, ont été sévèrement réduits dans de nombreux pays ; il s'en est suivi une baisse de la demande de chercheurs. En Amérique du Nord et au Royaume-Uni, certains indices permettent de penser que depuis quelque temps, les titulaires de Ph. D éprouvent des difficultés à trouver un emploi qui réponde à leurs qualifications, et certains signes annoncent une crise de l'emploi du personnel scientifique. Le récent développement des études universitaires de troisième cycle est assez significatif : il peut être considéré comme une réaction au volume croissant de connaissances scientifiques qu'il faut avoir pour s'engager dans une carrière indépendante, ou encore comme une réaction à l'absence de postes permanents, c'est-à-dire à une situation de chômage dissimulé. Il est important d'établir une distinction entre la demande future probable du système d'enseignement supérieur et celle des autres employeurs - gouvernement, et industrie - en matière de titulaires de doctorats. Dans quelle mesure les compétences acquises au cours de la préparation au doctorat sont-elles essentielles pour obtenir un emploi dans l'industrie ou un poste dans divers services gouvernementaux. Les avis des industriels à ce sujet diffèrent mais, bien entendu, les entreprises industrielles présentent, elles aussi, des différences. Il n'en est pas moins vrai que l'on connaît assez mal l'emploi de la main-d'oeuvre pour ce niveau de spécialisation. Enfin, on peut se demander quelle devra être l'ampleur des mesures à prendre pour l'enseignement au-delà du doctorat dans les disciplines scientifiques .

(c) La planification des études universitaires de troisième cycle

L'élaboration de plans spécifiques et détaillés pour l'enseignement supérieur, sur quelque base que ce soit, soulève de sérieuses difficultés en matière de conception. Les considérations relatives à la main-d'oeuvre créent des difficultés pour les raisons suivantes :

- (i) L'offre est difficile à évaluer, tant en raison de sa médiocre corrélation avec la "production" du système d'enseignement que de l'incertitude qui plane sur les carrières choisies par les étudiants.
- (ii) L'offre et la demande ne sont pas des variables indépendantes, elles réagissent l'une sur l'autre par l'intermédiaire du marché du travail.
- (iii) Il est dangereux de tenter de réglementer le nombre de places en fonction de l'évaluation de la situation actuelle faite par les employeurs, si précise que soit cette évaluation.
- (iv) On ne sait pas bien s'il faut lier à l'offre le "besoin" ou la "demande". La plupart des prévisions nationales (relatives à la main d'oeuvre scientifique) ont utilisé le premier de ces critères, mais ce concept est vague.
- (v) Des objections d'ordre idéologique s'opposent à l'élaboration des dispositions concernant l'enseignement en fonction des plans de main-d'oeuvre, car de nombreux pays estiment que la "demande sociale" est l'élément déterminant essentiel.

Le soutien de la recherche universitaire, particulièrement dans le domaine des sciences physiques, par des sources diverses, tant gouvernementales que non gouvernementales, crée également de sérieuses difficultés. L'un des principes généralement reconnus de la politique scientifique est qu'un financement important de la recherche universitaire par les utilisateurs est souhaitable. Néanmoins, lorsque le soutien financier accordé émane de sources multiples, les centres d'influence - ayant peut-être des conceptions différentes du rôle de l'enseignement de la recherche, et éventuellement difficiles à coordonner - sont également nombreux. Les considérations relatives à la recherche et à la main-d'oeuvre peuvent en conséquence suggérer diverses formules optimum de répartition de la responsabilité financière. La planification des études universitaires de troisième cycle dans les pays de l'OCDE à structure fédérale pose une difficulté supplémentaire due à ce que le financement de l'enseignement incombe fréquemment aux provinces ou aux états alors que le soutien de la recherche relève presque toujours de la compétence du gouvernement fédéral. La planification des études universitaires de troisième cycle risque de se trouver prise par défaut entre les deux écoles de la politique de l'enseignement d'une part et de la politique scientifique de l'autre. Peut-être l'heure est-elle venue de reconnaître la nature particulière de ces études, et de mettre en lumière leur fonction particulière, en acceptant les conséquences de cette situation sur l'élaboration du processus de planification dans ce domaine.

Considérations finales

Enfin, il est suggéré que dans les sciences pures (à l'exclusion des autres disciplines) d'importantes pressions s'exercent sur le plan international en faveur d'un système uniforme de diplômes du type Ph. D. Il est important d'évaluer les incidences qu'aurait un tel système, compte tenu de l'expérience actuelle des pays où il fonctionne depuis quelque temps. Il est également important de reconnaître que, dans les disciplines scientifiques, un tel doctorat ne doit pas être la seule possibilité offerte au niveau des études universitaires de troisième cycle ; il est indispensable de prévoir la préparation de doctorats ayant une finalité professionnelle autre que l'exercice de la recherche.

I. INTRODUCTION

Bien que les études universitaires de 3ème cycle n'aient peut-être pas été jusqu'ici le thème central des discussions sur les problèmes de l'enseignement supérieur, il n'y a aucun doute que leur importance est de plus en plus largement reconnue. De nombreux rapports préparés dans les pays de l'OCDE et se rapportant soit aux problèmes de l'enseignement supérieur, soit à ceux de la politique scientifique ont pour objet d'examiner les problèmes spécifiques du troisième cycle. Au demeurant, il ne faut pas oublier que cette question se rattache aussi bien à la politique scientifique qu'à la politique en matière d'enseignement.

Les étudiants qui ont dépassé le premier diplôme universitaire non seulement étudient et enseignent à la fois, mais apportent aussi une contribution très appréciable à l'effort de recherche universitaire. De ce fait, les problèmes de l'enseignement et de la recherche au-delà du premier diplôme universitaire - surtout dans le domaine des sciences pures sont soit le thème principal, soit un important thème accessoire d'un nombre croissant de rapports et de travaux de commissions. Ainsi, aux Etats-Unis le National Science Board a publié en 1969 (1) deux documents importants sur la politique relative aux études universitaires de 3ème cycle, et a effectué par la suite une étude en vue de déterminer les incidences des réductions des dépenses fédérales sur ce 3ème cycle (2). Ces réductions jointes au chômage croissant des titulaires de Ph. D. aux Etats-Unis ont amené des organismes scientifiques (tels que l'American Institute of Physics) à se préoccuper tout particulièrement de ce problème. Au Canada, de récents rapports du Conseil de la Science et du Conseil national de la Recherche (3) ainsi que le volume déjà publié du rapport du Comité spécial du Sénat sur la politique scientifique (4) avaient pour but d'examiner cette question - et très fréquemment le problème du chômage et du nombre excessif de titulaires du diplôme de Ph. D.

Au Japon, une Commission d'enquête de l'Association des Universités nationales a été chargée d'examiner les problèmes que posent l'introduction de types nouveaux d'études universitaires de 3ème cycle et l'organisation des cours à ce niveau dans les divers établissements d'enseignement supérieur japonais ; elle a publié un rapport préliminaire en novembre 1969 (5). En France, il est vrai, les

(1) Voir annexe F.

(2) Impact of Changes in Federal Science Funding Patterns on Academic Institutions, National Science Foundation (Washington, octobre 1970).

(3) Voir annexe A

(4) La politique scientifique du Canada. Rapport du Comité spécial du Sénat (Ottawa, 1970).

(5) Standing Committee N° 1 : "Innovating Graduate Course", First Preliminary Report. Association of National Universities (Tokyo, novembre 1969).

récentes réformes ont porté davantage sur les problèmes urgents des premier et deuxième cycles de l'enseignement supérieur et sur le problème d'ensemble des structures universitaires. Néanmoins, elles ont conduit (en 1966) à la suppression du diplôme d'études supérieures et à l'introduction du diplôme de maîtrise. En Allemagne, les études universitaires de 3ème cycle ont bénéficié d'un important programme d'aide fédéral qui a été mis en application en 1971. Au Royaume-Uni, on trouve dans le rapport Swann sur l'afflux des diplômés en sciences vers des emplois (ainsi que dans un certain nombre d'autres rapports) l'expression de sérieuses préoccupations suscitées par un désaccord apparent entre l'enseignement magistral et les besoins des employeurs. La nécessité de détourner de nombreux étudiants préparant un diplôme de Ph. D. orienté vers l'université et la recherche pour les diriger vers des cours sanctionnés par un Master's Degree davantage axé sur les professions a été depuis quelques années le thème central du Council for Scientific Policy (Conseil de la Politique scientifique) et du Science Research Council (Conseil de la Recherche scientifique). Dans de nombreux pays de l'OCDE qui n'ont pas de diplôme analogue au Ph. D. (par exemple Italie, Norvège, et Pays-Bas), nombre de ceux qui se préoccupent spécifiquement de l'avenir de la science fondamentale ont instamment demandé la création d'un tel doctorat.

Enfin, il faut faire observer que le recyclage en cours de carrière (ou "enseignement continu") est un aspect des études universitaires de 3ème cycle tout aussi important que d'autres qui font ici l'objet d'examens approfondis. L'importance même de cette question en justifie l'omission, elle est en effet beaucoup trop lourde de conséquences pour être étudiée accessoirement. Il est évident que bien d'autres points extrêmement intéressants ont dû aussi être laissés de côté, notamment le statut (souvent ambigu et incertain) des étudiants qui ont obtenu le premier diplôme universitaire, et leur rôle dans l'enseignement des premiers cycles. Ces deux problèmes ne seront malheureusement pas traités dans ce rapport.

En résumé, nous estimons qu'en raison des liens qui les rattachent à la fois au système d'enseignement supérieur et au système de recherche, les études universitaires de 3ème cycle constituent aujourd'hui une question d'importance croissante. La récente évolution de la politique scientifique a beaucoup ajouté à l'intérêt qu'elles éveillent dans les divers pays. Toute discussion sur la place que tiendra la recherche dans l'"université de masse" devra en faire état : à mesure que la recherche se dissociera davantage de l'enseignement, l'élaboration d'une politique de l'enseignement exigera une évaluation préalable des travaux accomplis au-delà du premier diplôme universitaire.

Le présent document se fonde essentiellement sur de précédents travaux de l'OCDE concernant le développement de l'enseignement supérieur (1) et sur une série d'études de cas par pays portant sur les études universitaires de 3ème cycle au Canada, en France, en République fédérale d'Allemagne, en Norvège, au Royaume-Uni et aux Etats-Unis d'Amérique (ces études se trouvent en annexes). Dans l'annexe finale les problèmes

(1) Développement de l'enseignement supérieur, 1950-1967. Statistiques par pays,
OCDE (Paris 1970).

spéciaux auxquels doivent faire face les pays Membres de l'OCDE en voie de développement en matière de politique d'enseignement sont brièvement passés en revue.

Le plan général de ce rapport est le suivant : Section II - définition des études universitaires du 3ème cycle dans le contexte de ce document. Section III - développement des études supérieures de 3ème cycle en termes statistiques. Section IV - quelques uns des facteurs à l'origine de ce développement. Section V (la dernière mais peut-être la plus importante) - examen de certaines questions qui relèvent plus particulièrement de la politique suivie actuellement dans ce domaine.

II. NATURE DES ETUDES UNIVERSITAIRES DE TROISIEME CYCLE

Dans les sections qui suivent nous définirons, en termes statistiques, le développement des études universitaires de 3ème cycle et nous tenterons de décrire certains des facteurs qui sont à l'origine de cette expansion. Cependant, nous devons auparavant préciser le sens que nous donnons à l'expression "études universitaires de 3ème cycle" en fonction du contenu et des structures de cet enseignement. Toute comparaison internationale est difficile à faire ici, surtout parce que les diplômes universitaires élevés (comme le doctorat) ont des incidences très différentes selon les pays sur le plan intellectuel ou social, de la fonction, et du contenu ; peu de concepts utilisés dans le domaine de l'enseignement sont aussi ambigus.

Il est sans doute exact de dire que les études universitaires de 3ème cycle groupent les types suivants d'enseignement : formation aux méthodes de la recherche (enseignement de doctorat), formation professionnelle et développement des connaissances dans la branche dans laquelle l'étudiant a obtenu son premier diplôme - ce dernier enseignement peut faire l'objet d'un cours d'un ou de deux ans succédant immédiatement au précédent cycle d'études, ou d'un cours de perfectionnement en cours de carrière d'une durée comprise entre un mois et un an ; il peut, ou non, être sanctionné par un diplôme supplémentaire. La formation professionnelle prend des formes diverses : même dans le cadre d'une profession déterminée, telle que le droit, la médecine ou l'enseignement, (formation pédagogique), les différences entre les pays sont importantes. En droit et en médecine par exemple, la formation est en général déterminée en partie par des organismes professionnels, composés d'hommes souvent très âgés, qui défendent jalousement leurs privilèges traditionnels. En conséquence, la formation professionnelle est fréquemment répartie entre le système d'enseignement formel et la pratique. La répartition exacte de la formation globale d'un juriste ou d'un médecin entre la faculté d'une part et les études extra-muros de l'autre, varie très largement selon les pays ; parfois, elle est avant tout déterminée par des considérations traditionnelles sur le statut professionnel. L'organisation de la partie formelle de l'enseignement professionnel est elle-même très sensiblement différente d'un pays à l'autre. Quelle est la partie de la formation formelle (intra-muros) d'un juriste ou d'un enseignant qui correspond aux quatre premières années d'études et quelle est la partie qui correspond aux études universitaires de 3ème cycle ? Prenons, par exemple, la formation des enseignants. Aux Etats-Unis, les professeurs des établissements du second degré doivent en général être titulaires d'un M. Ed. consécutif au premier diplôme universitaire bien que les règlements locaux soient variables. Jusqu'à tout récemment, au Royaume-Uni,

les étudiants ayant obtenu leur premier diplôme pouvaient enseigner dans les écoles secondaires sans aucune formation pédagogique, mais cette règle sera prochainement abrogée, et un diplôme pédagogique octroyé au bout d'une année d'études de 5ème cycle sera exigé de tous les enseignants. En France, diverses qualifications d'études du niveau de 5ème cycle sont sanctionnées par des concours de recrutement des enseignants tels que le C.A.P.E.S. et l'agrégation. Dans le domaine du droit, les étudiants britanniques entreprennent la partie pratique de leur formation immédiatement après avoir acquis leur premier diplôme, alors que les étudiants américains effectuent d'abord des études de 5ème cycle à la faculté de droit.

La préparation à la recherche, plus simple en un sens parce que les considérations traditionnelles de statut professionnel n'interviennent pas, est d'autre part plus complexe parce qu'elle constitue en même temps une formation professionnelle, à un degré qui varie d'un pays à l'autre. En d'autres termes, pour être accepté parmi les membres de la communauté scientifique, un chercheur professionnel doit compléter ses études universitaires formelles (doctorat) par une formation professionnelle plus ou moins poussée selon les pays.

Sur un point important - et un seul - les études universitaires de 5ème cycle sont moins compliquées que les cycles d'études qui les précèdent : les établissements où elles s'effectuent sont beaucoup moins nombreux que ceux qui dispensent un enseignement de degré inférieur. A l'exception de la formation pratique qui peut être placée sous le contrôle des associations professionnelles, les études universitaires de 5ème cycle sont concentrées dans un groupe relativement réduit d'institutions universitaires de chaque pays. Aux Etats-Unis, par exemple, alors que les Bachelors Degrees sont offerts par près de 2.000 établissements, environ 700 institutions seulement octroient le Master's Degree et 200 à 300 le diplôme de Ph. D.

Le présent rapport est pratiquement limité à l'étude de ce que nous avons appelé formation à la recherche, et nous n'abordons pas les problèmes très particuliers de la formation aux professions traditionnelles. En d'autres termes, nous limitons notre analyse aux études consécutives à l'obtention d'un diplôme de niveau universitaire qui impliquent au moins un élément de recherche. La durée des études qui entrent dans cette définition est indiquée, pour quelques pays, dans le tableau ci-après qui concerne particulièrement les sciences pures.

Dans les disciplines scientifiques, pour des raisons qui seront examinées plus loin, la distinction entre les travaux antérieurs et postérieurs au premier diplôme universitaire est un peu plus nette que dans le cas des lettres et de la philosophie. Ainsi, en Allemagne par exemple, dans les disciplines scientifiques, le doctorat est essentiellement décerné aux étudiants qui ont déjà obtenu le premier diplôme universitaire : environ 86 % des docteurs ès sciences sont titulaires d'un diplôme inférieur alors qu'ils ne sont que 4 % dans les disciplines enseignées dans les facultés de philosophie. En d'autres termes, les facultés de philosophie maintiennent le doctorat comme diplôme terminal (traditionnel) de l'enseignement universitaire. De récentes réformes en Allemagne (et dans les cantons suisses de langue allemande) ont entre

	Limite Inférieure	Limite supé- rieure	Durée moyenne (en an- nées)	Autres diplômes supé- rieurs
Canada	Bachelor's/Master's Degree	Ph. D.	5 - 6	Doctorat d'Etat
France	Licence/Maîtrise	Doctorat de 3ème cycle	3 ½	
Allemagne	Diplôme/Examen d'Etat	Doctorat	2 - 4	
Norvège	Cand.Mag.	Cand.Real.	2 ½	Dr. Phil.
Royaume- Uni	Bachelor's/Master's Degree	Ph. D.	3 ½	
Etats-Unis	Bachelor's/Master's Degree	Ph. D.	5 - 6	

autres introduit le diplôme de M.A. (licence) que les étudiants des facultés de philosophie peuvent obtenir s'ils ne souhaitent ni passer l'Examen d'Etat qui est exigé des enseignants (en lieu et place d'un diplôme) ni consacrer un temps très long à préparer un doctorat.

En France également, des différences existent entre les structures des diplômes des facultés des sciences et des lettres et sciences humaines d'une part, et des autres facultés d'autre part. Dans les facultés des sciences, le système est le suivant : le deuxième cycle long de l'enseignement supérieur (maîtrise) est suivi d'une année d'études destinées à donner à l'étudiant des connaissances détaillées dans le domaine de recherche de son choix, qui conduit au "Diplôme d'Etudes Approfondies" (D.E.A.). L'étudiant effectue ensuite une à trois années de recherche, à l'issue desquelles il présente une thèse pour obtenir le doctorat de spécialité (dit de "troisième cycle"). Ce système de diplôme a été introduit d'abord dans les sciences puis dans les lettres. Jusqu'en 1963, le seul doctorat offert par la faculté de droit et de sciences économiques était le doctorat d'Etat qui exigeait la préparation d'une thèse, et cinq à six années d'études et de recherches. Un doctorat de troisième cycle, accéléré et plus spécialisé dans ces exigences, a été introduit en 1963. Dans tous les domaines le doctorat d'Etat conserve son importance en tant que passeport essentiel à une chaire universitaire. Ainsi, comme en Allemagne, les systèmes anciens et nouveaux se superposent - un nouveau diplôme de recherche comme le Ph.D. coexistant avec le doctorat traditionnel.

Il en est de même dans de nombreux pays européens. De nouvelles structures se sont ajoutées aux anciennes, en raison de la durée excessive des études conduisant à des diplômes traditionnels (et en conséquence du taux d'échecs élevé), et aussi des besoins particuliers des chercheurs en sciences pures. Dans ce dernier domaine, on constate que des pressions, répondant à des besoins communs, s'exercent dans tous les pays, en vue d'obtenir l'équivalence des diplômes. Les systèmes anciens, même quand ils sont modifiés comme en Allemagne de manière à comporter un stade correspondant aux quatre premières années de l'enseignement supérieur, ne donnent pas de qualifications essentiellement professionnelles. Ni le doctorat ès sciences allemand ni le Cand. Real. norvégien ne confèrent officiellement les compétences professionnelles qui sont de plus en plus exigées des chercheurs. Dans ces pays, on constate que les chercheurs réclament de plus en plus l'institution d'un doctorat professionnel relativement accéléré - un Ph. D. Les pays (comme l'Italie et les Pays-Bas) qui n'ont apporté aucune modification, même mineure, à leurs systèmes traditionnels doivent faire face à des problèmes plus graves encore. Le caractère international et professionnel de la science, et l'attrait particulier qu'exerce le diplôme de Ph.D. offert par les universités des Etats-Unis font que des pressions s'exercent pour obtenir une équivalence des diplômes qui n'existe pas dans d'autres domaines. Ces pressions ont pour objet l'institution d'un diplôme comme le Ph. D. américain, qui exige à la fois des recherches dirigées et un enseignement de haut niveau. L'un ou l'autre de ces éléments fait fréquemment défaut dans les diplômes postérieurs au premier diplôme universitaire, même en sciences. En d'autres termes, tout récemment encore par exemple, le doctorat britannique ne comportait que très peu de cours magistraux : en biologie, à peine 10 % des départements universitaires offrent un tel enseignement. Les départements où les études universitaires de 3ème cycle sont sanctionnées par un examen sont relativement peu nombreux. Le problème est différent en Allemagne et en Norvège ; les étudiants qui ont entrepris la préparation de leur thèse reçoivent relativement peu d'aide et sont laissés à leur propre initiative. En France, comme nous l'avons vu, des réformes successives ont conduit à une situation dans laquelle l'accès à l'enseignement de 3ème cycle est maintenant conditionné par l'obtention du diplôme d'études approfondies (D.E.A.) (1). Aux Etats-Unis, les candidats au doctorat obtiennent d'abord, pour la plupart, leur Master's Degree, la chimie est la seule des grandes disciplines académiques où il n'en est pas ainsi (40 % seulement) : dans toutes les autres branches, 79 % des titulaires de doctorats ont passé auparavant un Master's Degree. Bien que celui-ci soit utile en tant que contrôle officiel des connaissances de l'étudiant, il en est résulté un déclin important du statut du Master's Degree qui est maintenant considéré comme une simple étape vers le Ph. D. ou l'indice d'une inaptitude à terminer les cours qui y mènent.

(1) Une "attestation d'études approfondies" est délivrée, à la fin de leurs études, à ceux qui ne semblent pas capables de poursuivre des recherches.

La nature exacte des systèmes nationaux de diplômes est examinée dans les études de cas : la discussion ci-dessus avait pour objet non seulement de mettre en lumière les problèmes que posent de telles comparaisons, mais aussi de placer dans leur contexte certaines des questions examinées plus loin. La principale conclusion qu'il ne faut pas perdre de vue est la coexistence des systèmes anciens et nouveaux, dans la plupart des pays, ainsi que les pressions qui s'exercent presque partout pour obtenir l'institution d'un diplôme du type Ph. D. dans les disciplines scientifiques.

III. ASPECT STATISTIQUE DU DEVELOPPEMENT DES ETUDES UNIVERSITAIRES DE TROISIEME CYCLE

Le tableau 1 indique le nombre de diplômes supérieurs accordés dans les pays Membres de l'OCDE au cours de certaines années sélectionnées, ainsi que leur répartition par branches d'études. Cette répartition fait ressortir un certain nombre d'éléments intéressants.

Par exemple, on constate que dans les pays Membres en voie de développement le pourcentage de diplômes supérieurs accordés en sciences ou en technologie est assez bas (à l'exception de la Yougoslavie, et dans une certaine mesure de l'Espagne). En revanche, dans plusieurs des petits pays industrialisés, l'accent est très fortement mis sur les sciences. Certains pays manifestent une tendance à s'orienter vers les lettres et les humanités, d'autres vers la médecine, les Etats-Unis vers la branche éducation. Certains pays n'ont fourni aucun renseignement pouvant être portés sur le tableau. Enfin, c'est l'irrégularité, plutôt que la régularité, de ces données qui est frappante. En fait, aucun niveau d'enseignement n'est sujet à autant de variables, et n'est exploité de manières si diverses et à des fins si multiples que les études universitaires de 3ème cycle.

Ces études se sont développées en Europe par un processus de juxtaposition des besoins en main-d'oeuvre, de la science, de la technologie et de l'économie sur les systèmes traditionnels, et souvent rigides, de l'enseignement supérieur. La plupart des pays européens traverseraient donc une période d'expérimentation dans laquelle coexistent des systèmes anciens et nouveaux d'études universitaires de 3ème cycle. Les variations des données statistiques - qui seraient fortement accentuées si l'on avait considéré les changements de la répartition par branches d'études au cours du temps - sont donc principalement le reflet de ces deux facteurs : la diversité des fonctions et les changements fréquents qui en résultent.

L'expérimentation ne s'est pas faite à échelle réduite. En fait, si l'on peut se permettre une généralisation, c'est bien de constater que le taux de croissance des effectifs des études de 3ème cycle a été surprenant. Presque partout, le nombre de diplômes supérieurs accordés a doublé dans un délai de cinq à six ans (tableau 2). L'ampleur de cette expansion se dégage de manière irréfutable d'une comparaison avec le développement de l'enseignement supérieur à un niveau moins élevé.

Dans sept des douze pays cités au tableau II, le nombre de diplômes de niveau élevé s'est développé à une cadence annuelle supérieure à celle des premiers diplômes entre 1960/1961 et 1965/1966. L'Allemagne est restée stationnaire à l'un et l'autre niveaux, c'est seulement en Suède et en Suisse que les premiers diplômes ont augmenté sensiblement plus que les diplômes de niveau supérieur ; au Japon et en Yougoslavie la différence est considérable.

TABLEAU 1

Diplômes supérieurs délivrés et répartition par branches d'études

	Nombre de diplômes supérieurs délivrés dans toutes les branches d'études				Répartition par branches d'études 1965/66 (en pourcentages)							
	1950/51	1960/61	1965/66	1966/67	Sciences pures	Technologie (y compris l'architecture)	Agriculture	Sciences médicales	Lettres et beaux-arts	Education	Droit	Sciences sociales
Autriche (1)(2)	...	482	753	803	-	8,9	3,8	0,3	-	-	73,3	13,7
Belgique (3)	118	196	210	276	46,2	4,8	5,7	1,9	31,0	0,4	0,5	9,5
Danemark	...	50	63	...	14,0	4,6	6,3	48,8	22,1	-	2,1	2,1
Finlande	106	174	343	302	28,3	16,3	5,2	17,5	16,3	-	6,1	10,2
France	(1951/2) 514	5.110	8.555	11.213	37,7	-	-	1,1	43,5	-	17,8	-
Allemagne (1)	...	5.244	5.413	...	21,4	9,0	7,0	47,5	0,8	-	9,6	4,7
Grèce	...		293	192	9,6	4,1	1,3	76,5	5,1	-	2,4	1,0
Islande	-	-	-	-	-	-	-	-	-	-	-	-
Irlande	-	625	955 ⁴	...	6,8	2,7	2,0	8,4	13,2	61,8	0,9	4,3
Italie	-	-	-	-	-	-	-	-	-	-	-	-
Luxembourg	-	-	-	-	-	-	-	-	-	-	-	-
Pays-Bas	-	-	-	-	-	-	-	-	-	-	-	-
Norvège	168	151	393	...	51,6	0,7	1,3	6,4	33,0	-	0,5	6,3
Portugal	-	-	-	-	-	-	-	-	-	-	-	-
Espagne	...	699	615	540	26,7	-	2,9	36,7	18,2	-	11,5	3,9
Suède	360	521	749	903	30,6	18,7	3,7	15,1	20,4	-	0,7	10,8
Suisse	662	553	640	752	40,5	3,9	3,1	-	18,3	-	12,5	21,7
Turquie	...		209	236	7,7	15,8	1,2	51,7	10,5	-	3,3	9,1
Royaume-Uni	...	11.245	17.448	20.217	17,9	10,7	1,5	10,9	38,3	10,9	-	9,8
Yougoslavie	42	232	593	582	19,6	11,8	16,4	13,7	19,5	0,8	4,4	13,8
Canada	...	2.751	5.930	7.033	18,8	10,3	2,9	4,0	21,3	16,8	0,2	25,8
Japon	...	3.665 ^x	9.806	11.789	13,6	27,4	6,6	29,1	13,7	0,1	-	9,6
Etats-Unis	72.470	88.844 ^x	159.011	178.513	13,8	11,8	1,8	2,1	18,7	36,1	0,6	14,3

Source : Développement de l'enseignement supérieur 1950-1967. Statistiques par pays et Rapport analytique (OCDE, 1970 et 1971).

(1) Un diplôme antérieur est exigé.

(2) Autrichiens seulement.

(3) Doctorats.

... Données non disponibles.

x 1961/62.

4 1964/65.

TABIEAU 2
Taux d'accroissement annuel moyens (1960/61 - 1965/66) des diplômes délivrés dans certains pays électionnés

	Niveau du premier diplôme			Niveau des diplômes supérieurs					
	Nombre de diplômes délivrés	Taux d'accroissement		Au-dessous du doctorat		Doctorat			Taux d'accroissement
				Nombre de diplômes délivrés	Pourcentage d'augmentation	Nombre de diplômes délivrés			
	1960/61	1965/66		1960/61	1965/66	1960/61	1965/66		
Belgique	4.173	5.332	4,9	2.448	5.227	196	210	1,4	1,4
Canada	20.085	38.120	12,4	578	1.043	303	703	15,5	15,5
Finlande	2.526	4.062	9,2	3.799	5.604	88	150	10,4	10,4
France	13.562	23.557	10,9	2.612*	5.938	1.311	2.951	15,4	15,4
Allemagne	21.211	21.504	0,3	119	334	6.246	6.265	0,1	0,1
Japon	121.979	178.279	7,4	330	510	1.053*	3.868	28,6	28,6
Norvège	1.016	1.643	9,4	119	334	32	59	11,7	11,7
Suède	4.067	6.454	9,1	330	510	191	239	4,5	4,5
Suisse	1.776	2.463	6,5	-	-	553	640	2,9	2,9
Royaume-Uni	27.176	38.696	7,0	78.269	140.772	11.245(a)	17.448(a)	8,7	8,7
Etats-Unis	401.784	555.613	6,4	98	457	10.575	18.239	11,6	11,6
Yugoslavie	11.548	12.418	1,5	-	-	232	136(b)	-	-

* 1961/62.

(a) Master's Degree et doctorat

(b) Règlements modifiés.

De nombreux indicateurs pourraient être utilisés pour mesurer l'expansion relative de l'enseignement supérieur des premiers et du troisième cycles : modification du pourcentage des diplômes délivrés à chaque niveau, modifications des dépenses relatives (si celles-ci peuvent être disponibles), modifications des effectifs relatifs d'étudiants et modifications du taux de transition entre ces cycles d'études. Le principe général selon lequel les études de 3ème cycle se développent plus rapidement que l'enseignement des quatre premières années d'études (dans la majorité des pays) pourrait être établi par l'étude de l'un quelconque de ces indices. Pour le planificateur en matière d'enseignement - préoccupé par les dispositions qu'il faut prendre pour l'enseignement supérieur - les deux derniers ont une signification particulière. Les responsables de la politique scientifique s'inquiéteront peut-être davantage des diplômes - et de l'afflux vers le système économique. Les effectifs relatifs d'étudiants - combinés aux données sur les coûts relatifs - permettent de se faire une idée de la part des ressources qu'absorbe chacun des niveaux de l'enseignement supérieur - ce qui est évidemment important.

Dans le tableau 3 nous avons essayé d'estimer les proportions d'effectifs des études de 3ème cycle dans quelques pays en considérant selon les cas tous les étudiants des Postgraduate Studies des 3ème cycle d'études ou les "étudiants promus". Il apparaît qu'au Canada, aux Etats-Unis et en France, le pourcentage est dans chaque cas de 10%, il est sensiblement supérieur en Norvège et au Royaume-Uni, mais alors qu'il augmente encore au Royaume-Uni, il diminue depuis longtemps en Norvège (à mesure que les diplômes inférieurs - par exemple le Cand. Mag. - sont plus largement acceptés. En Allemagne, enfin, il est extrêmement bas, et bien que les chiffres cités (qui indiquent le nombre d'étudiants inscrits mais ayant passé le premier Examen d'Etat ou examen en vue d'un diplôme par rapport au nombre total d'étudiants) ne soient pas très précis, ils donnent bien l'ordre de grandeur. En fait, cette situation résulte essentiellement de la possibilité d'obtenir comme par le passé un doctorat dans de nombreuses disciplines (1), sans avoir acquis le diplôme de niveau précédent.

Malheureusement, il y a peu de renseignements sur les coûts comparés des quatre premières années d'études universitaires et des études de 3ème cycle. Au Canada, la Commission Biaden (2) a estimé qu'en moyenne un étudiant de 3ème cycle coûte trois ou quatre fois plus qu'un étudiant des quatre premières années d'études. Selon une

(1) Ainsi, en 1964/1965, les pourcentages de doctorats délivrés à des étudiants qui avaient obtenu des diplômes inférieurs étaient les suivants : sciences 86%, technologie, agriculture, médecine 100%, droit 100%, sciences sociales 75%, arts, lettres, philosophie 4%.

(2) Association des universités et collèges canadiens Commission sur le financement de l'enseignement supérieur au Canada (Toronto 1965).

TABLEAU 3

Evolution des proportions des effectifs d'étudiants de 3ème cycle
 (par rapport aux effectifs totaux de l'enseignement universitaire)

Royaume-Uni	<u>1938/39</u> 6,2	<u>1946/47</u> 5,1	<u>1952/53</u> 14,4	<u>1955/56</u> 14,9	<u>1960/61</u> 16,6	<u>1961/62</u> 17,1
	<u>1966/67</u> 17,4	<u>1968/69</u> 17,9				
Canada	<u>1920/21</u> 1,8	<u>1930/31</u> 4,3	<u>1940/41</u> 4,3	<u>1950/51</u> 6,6	<u>1959/60</u> 5,2	<u>1963/64</u> 7,0
	<u>1964/65</u> 7,8	<u>1965/66</u> 8,4	<u>1966/67</u> 9,0	<u>1967/68</u> 9,3		
Norvège	<u>1951/52</u> 38	<u>1954/55</u> 34	<u>1957/58</u> 28	<u>1960/61</u> 23	<u>1963/64</u> 20	<u>1964/65</u> 19
Etats-Unis	<u>1920</u> 2,6	<u>1930</u> 4,3	<u>1940</u> 7,1	<u>1950</u> 11,0	<u>1955</u> 9,0	<u>1960</u> 9,9
	<u>1962</u> 10,0	<u>1964</u> 10,4				
Allemagne	<u>1952</u> 7,2*	<u>1959</u> 3,1*	<u>1966</u> (2-3)			
France	<u>1958/59</u> 9,8	<u>1966/67</u> 10,7				

* Estimations de G. Bengeser.

TABLEAU 4

Taux de transition (estimés) en sciences pures (1)

	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1968</u>
Royaume-Uni	0,26	0,27	0,30	0,31	0,30	0,27
Norvège	<u>1953/54</u> 0,93	<u>1958/59</u> 0,86	<u>1960/61</u> 0,54	<u>1965/66</u> 0,73		
Etats-Unis	<u>1951/52</u> (0,18) <u>1962/63</u> (0,23)	<u>1952/53</u> (0,19)	<u>1953/54</u> (0,21)	<u>1956/57</u> (0,19)	<u>1957/58</u> (0,19)	<u>1959/60</u> (0,20)
Allemagne	<u>1957</u> (0,54)	<u>1958</u> (0,48)	<u>1959</u> (0,45)	<u>1960</u> (0,42)	<u>1961</u> (0,40)	<u>1962</u> (0,37)
France			<u>1963/64</u> (0,36)	<u>1964/65</u> (0,38)	<u>1965/66</u> (0,51)	<u>1966/67</u> (0,46)

(Les chiffres entre parathèses sont des estimations)

(1) La manière dont ces taux ont été calculés est exposée dans les études de cas individuelles.

estimation très simplifiée, si nous prenons un rapport de 1 à 3 et un effectif relatif d'étudiants de 10 %, nous parvenons à la conclusion que 25 % de toutes les ressources consacrées à l'enseignement universitaire seraient affectés aux études de 3ème cycle.

Le taux de transition, c'est-à-dire le pourcentage d'étudiants ayant obtenu le premier diplôme et qui poursuivent leurs études ou leur formation est un deuxième indice qui permet de mesurer l'expansion des études de 3ème cycle. Par une simple soustraction on obtient aussi le pourcentage des étudiants munis d'un premier diplôme qui prennent un emploi. En conséquence, cet indice est important, à la fois pour définir rapidement l'évolution des choix des étudiants (plus rapidement que ne peut le faire la comparaison entre les diplômes délivrés qui ne donne une réponse qu'avec un retard appréciable) et pour prévoir les effectifs d'étudiants pour les années à venir. Il est important de souligner qu'il s'agit là d'un indice qui varie sensiblement, dans tous les pays, selon les branches d'études. En Allemagne, par exemple, les taux de transition en chimie, en génie mécanique et en économie (1962) étaient (d'environ) 0,87, 0,12, 0,13 respectivement. La comparaison des taux estimés pour l'ensemble des branches d'études est donc beaucoup moins significative que celle des taux des branches individuelles. Le tableau 4 représente les taux de transition pour les sciences pures.

IV. ORIGINES DE L'EXPANSION

L'expansion de toute partie du système d'enseignement public est fonction de trois facteurs : les exigences des étudiants ou des élèves, les vœux des gouvernements et l'opinion publique (qui se manifeste par son choix politique). Ces trois facteurs, dont le premier ne s'applique qu'au niveau de l'enseignement non obligatoire réagissent manifestement les uns sur les autres de manière très complexe. En premier lieu, dans tout régime démocratique, les politiques gouvernementales doivent refléter d'une manière ou d'une autre l'opinion publique. La mesure dans laquelle la politique adoptée doit refléter l'opinion publique, pour des raisons d'opportunité politique, dépend non seulement de la nature du régime (qui ne retiendra pas notre attention ici), mais aussi du domaine auquel elle s'applique. Certains domaines de la politique gouvernementale sont plus politisés que d'autres : en d'autres termes, ils éveillent beaucoup d'intérêt dans l'opinion publique, qui s'exprime avec force soit par des groupes de pression soit lors des élections. Pour des raisons complexes et diverses, dans la plupart des pays l'enseignement est une question politisée de cette nature de même que la détérioration de l'environnement, alors que la politique scientifique est elle, beaucoup moins politisée. Or, sous la rubrique générale "éducation" il est clair que les préoccupations de l'opinion publique varient avec le niveau de l'enseignement : dans tous les pays, certains aspects de la politique de l'enseignement suscitent beaucoup plus de débats politiques que d'autres. Par exemple, l'accès à l'enseignement primaire ne pose aucun problème dans les pays de l'OCDE, mais il peut en être tout autrement de l'accès à l'enseignement secondaire, et l'organisation de cet enseignement suscite fréquemment des difficultés. Dans certains pays, il en va de même de l'enseignement supérieur. L'enseignement secondaire pour tous, dans certains pays, l'enseignement supérieur de masse dans d'autres sont des objectifs sociaux réalisables - c'est ce qui leur confère leur caractère politique - mais il n'en est pas de même des études universitaires de 3ème cycle. En effet, les études de 3ème cycle accessibles à la masse, ou l'égalité

des chances d'accès à ces études, ne visent pas des objectifs sociaux, et encore moins des objectifs réalisables - dans aucun pays, même pas aux Etats-Unis. Les politiques qui ont conduit à une expansion rapide de ces études ne sont aucunement le résultat d'un choix politique : elles diffèrent en cela des autres niveaux de l'enseignement supérieur. Deux facteurs déterminants restent donc valables : les exigences des étudiants et la politique gouvernementale (qui subit donc des influences technocratiques plutôt que populaires) (1).

L'enseignement non obligatoire ne peut se développer que si les étudiants le demandent et si soit eux, soit le gouvernement, sont disposés à y consacrer les ressources nécessaires. Si la demande des étudiants relative à un type particulier d'enseignement dépasse les moyens disponibles (comme c'est le cas, par exemple, pour les Grandes Ecoles en France, l'enseignement médical au Royaume-Uni, ou toute forme d'études supérieures en Turquie) il faut réorienter les étudiants (les encourager soit à poursuivre ailleurs leurs études, soit à se représenter l'année suivante) faute de quoi les gouvernements pourraient se trouver dans l'incapacité de faire face à la situation. En revanche, si les moyens disponibles dépassent la demande des étudiants (ce qui s'est produit par exemple pour l'enseignement scientifique et technologique au Royaume-Uni à la fin des années soixante) des places pourraient rester vides dans les universités, d'où une sous-utilisation des ressources physiques. Dans de telles circonstances, des plans normatifs n'ont guère de valeur. En d'autres termes, l'extraordinaire expansion des études universitaires de 3ème cycle, surtout dans le domaine des sciences pures, ne peut être que le résultat à la fois de la volonté et de la décision des étudiants comme des gouvernements de consentir les investissements nécessaires. (L'étude de la nature de ce financement fera l'objet de la Section V ; pour le moment, nous pouvons prendre pour hypothèse que - tout au moins en ce qui concerne les études universitaires scientifiques de 3ème cycle - le gouvernement est la principale source de financement direct dans tous les pays).

Il est impossible d'offrir une explication complète de cet ensemble complexe de décisions individuelles et gouvernementales. Les étudiants, comme les responsables de la politique de l'enseignement réagissent, consciemment ou inconsciemment, à toute une gamme de pressions économiques, sociales et épistémologiques. Nous nous bornerons à énumérer quelques-uns des facteurs qui pourraient fort bien avoir exercé une influence importante, soit sur les étudiants, soit sur les responsables de la politique, sans essayer de les pondérer de quelque manière que ce soit les uns par rapport aux autres.

A. Choix des étudiants

Le meilleur indice du choix des étudiants serait non pas le taux de transition réel entre l'enseignement conduisant au premier diplôme et aux diplômes supérieurs, mais le pourcentage d'étudiants qui auraient souhaité poursuivre leurs études au-delà des

(1) Certains types de formation professionnelle au-delà du premier diplôme, par exemple la formation médicale, constituent une exception à cet égard ; dans de tels cas le nombre optimum de médecins ou d'autres catégories de personnel professionnel pourrait fort bien être déterminé par un débat politique.

quatre premières années d'études. Dans certains pays, il est vrai que ces deux facteurs sont presque synonymes : par exemple, en Norvège et en Allemagne, dans le domaine des sciences pures presque tous les étudiants qui ont obtenu leur Cand. Mag. ou leur Examen de diplôme peuvent rester à l'université s'ils le souhaitent. De même, à la fin des années cinquante, Bernard Berelson, dans un ouvrage sur les études de 3ème cycle aux Etats-Unis, est parvenu à la conclusion que "tous ceux qui souhaitent s'engager dans des études universitaires de 3ème cycle y ont accès" (1). Au Royaume-Uni, la situation est différente : dans une étude sociologique sur les intentions des étudiants qui ont terminé leurs quatre premières années d'études, Donald Hutchings a constaté qu'environ 64 % des étudiants en sciences et 37 % des étudiants en technologie auraient souhaité poursuivre leurs travaux jusqu'au doctorat ou au Master's Degree (2), mais qu'ils n'ont été que 33 % et 19 % respectivement à l'avoir fait. Malheureusement nous n'avons pas de données analogues pour d'autres années ou d'autres pays. Cependant, ces chiffres qui correspondent à l'année 1964/65 sont importants pour la raison suivante : si les préférences des étudiants, exprimées en réponse à un questionnaire, sont le double du taux de transition réel, celui-ci peut augmenter considérablement sans qu'un changement intervienne nécessairement dans le choix des étudiants ; il s'agirait en fait d'un mécanisme d'utilisation des réserves.

Cependant, si tous les étudiants qui le souhaitent peuvent accéder aux études universitaires de 3ème cycle aux Etats-Unis (c'est-à-dire, s'il existe réellement une expansion déterminée par un besoin social) nous pouvons conclure que cette forme d'enseignement répond à une demande accrue. Peut-être en est-il de même dans d'autres pays mais nous n'avons pas d'informations à l'appui. Comment peut-on expliquer cette évolution des préférences des étudiants ? Malheureusement il n'existe pas de réponse unique. Les économistes l'expliqueraient en fonction du rendement des années supplémentaires d'études, mais il est douteux que ce raisonnement s'applique aux domaines autres que scientifiques (et même à ceux-ci). Dans l'étude citée plus haut, Berelson considère que le choix de l'enseignement de doctorat est davantage un glissement qu'un choix, c'est-à-dire un choix passif. D'autres sociologues pourraient évoquer le statut social attaché aux diplômes : à mesure que les Bachelor's Degrees deviennent plus courants, le prestige de leurs détenteurs s'amenuise inévitablement ; le maintien d'un statut élevé exige donc des qualifications supplémentaires. Bien que nous ne souhaitions pas choisir entre ces explications (qui sont de toute manière déterminées par les critères intellectuels de ceux qui les avancent) nous tenons à attirer l'attention sur l'importance de ces considérations de prestige, car elles peuvent opposer d'importantes barrières à toute réforme. En Allemagne, le diplôme de M.A. décerné par les facultés de philosophie (introduit en tant qu'alternative au doctorat et du diplôme pédagogique), en Norvège, le Cand. Mag. et en France le doctorat de 3ème cycle souffrent tous du manque de prestige attaché à certaines disciplines inscrites à leur programme ou à la totalité d'entre elles.

(1) B. Berelson : Graduate Education in the United States (McGraw-Hill, 1960), page 144.

(2) D. Hutchings : The Sciences Undergraduate (Oxford, 1967).

B. Spécialisation des connaissances

Le développement des connaissances, en particulier dans les sciences pures constitue un deuxième facteur qui influence inévitablement les étudiants. La croissance exponentielle de la science, explique Derek Price, se traduit par une multiplication du nombre des documents publiés (1). En raison de ce développement exponentiel, il faut acquérir un volume accru de connaissances pour comprendre en profondeur les phénomènes qui nous entourent. Certains philosophes, il est vrai, pourraient avancer, au contraire, que le progrès scientifique est essentiellement un processus de réduction - le raisonnement réduit un nombre de pourcentage croissant d'informations disponibles à un certain nombre de lois simples. Nous n'étudierons pas cette question ici. Le fait est que, plus les étudiants, les pouvoirs publics, ou les employeurs considéreront qu'un diplôme équivaut à une préparation complète à un emploi technique donné, plus les pressions s'exerceront en faveur de la poursuite des études. En d'autres termes, la conception professionnelle des études de 5ème cycle est nécessairement soumise à ce processus d'inflation des qualifications. Si, en revanche, on estime qu'un diplôme n'a pas de valeur professionnelle, il n'y a aucune raison pour que ce facteur s'applique bien que l'on ne puisse affirmer qu'il ne jouera pas. Un premier diplôme sans aucun caractère professionnel, par exemple le diplôme beaucoup moins spécialisé sanctionnant deux années d'études proposé au Royaume-Uni par le Professeur Pippard (2), pourrait également amener une demande accrue d'enseignement et de formation plus poussés. L'élément déterminant ici est que les employeurs consentent à assurer une formation et un enseignement "sur le terrain" et en cours de carrière.

C. La demande de chercheurs

Ce facteur, qui résulte du caractère professionnel du diplôme de Ph. D., est propre aux pays qui considèrent le doctorat comme une préparation à la carrière de chercheur professionnel. Parmi les diplômes supérieurs accordés dans les pays dont traitent les études de cas, nous pouvons dire qu'il en est ainsi des diplômes de Ph. D. américain, britannique et canadien, et du doctorat de spécialité en France, ce n'est pas le cas du doctorat allemand, ni du diplôme norvégien de Cand. Real. dont ni les étudiants, ni les employeurs ne pensent qu'ils garantissent une formation de chercheur. Toutefois, dans l'hypothèse où il en serait effectivement ainsi, une demande croissante de chercheurs impliquerait une demande également croissante de titulaires de diplômes Ph.D. : la manière dont cette relation de cause à effet se traduirait en une augmentation de l'offre est toutefois une question complexe.

(1) Price, D. de S. Voir, par exemple : Science Since Babylon et Little Science, Big Science.

(2) Pippard, Professeur A.B. Voir par exemple, son Annexe au Rapport Swann (H.M.S.O., Londres, 1968).

Ici encore, il faut se borner à dégager certains des facteurs qui lient ces deux questions, dont le plus évident est le mécanisme des prix et l'effet de la pénurie sur les traitements. L'influence des prévisions relatives aux besoins ou à la demande constitue un autre facteur, qui agit à la fois sur les étudiants et sur les pouvoirs publics.

Valeur des prévisions

La situation au Royaume-Uni illustre bien l'intérêt des prévisions, mais il en serait probablement de même de la situation dans d'autres pays (par exemple la France) où sont publiées des prévisions officielles de la main-d'oeuvre. Tout au long des années soixante, le Comité sur les ressources en main-d'oeuvre scientifique et technique a publié une série de rapports sur la main-d'oeuvre scientifique. Certains sont des études triennales sur le personnel et d'autres des études ad hoc sur les flux de main-d'oeuvre. Les études sur le personnel comportaient des estimations, fondées sur les évaluations individuelles des employeurs, relatives au taux d'emploi probable des chercheurs et des ingénieurs dans un délai de trois ans. Comme l'indique le tableau 5 les employeurs ont fortement surestimé le nombre de chercheurs et d'ingénieurs qu'ils pensaient pouvoir employer.

TABLEAU 5
ESTIMATION DE LA DEMANDE INDUSTRIELLE
Royaume-Uni

	Estimations faites en 1965 de l'emploi en 1967 de		Emploi effectif en 1968 de	
	<u>Chercheurs</u>	<u>Ingénieurs</u>	<u>Chercheurs</u>	<u>Ingénieurs</u>
(Toutes les industries manufacturières)	58 111	86 892	36 595	74 681

Sources : - Committee on Manpower Resources: Report on the 1965 Triennial Manpower Survey (Londres 1966) page 14.
- DES/Mintech Statistics of Science and Technology 1970 (Londres 1970) page 118.

Comme on le voit, les estimations relatives aux chercheurs étaient trop élevées de 4 %, et dans le cas des ingénieurs de 16 %. (Malheureusement aucune estimation n'a été faite concernant spécifiquement les titulaires de Ph. D. ou les chercheurs). La médiocrité de cette estimation peut s'expliquer par les difficultés que les industriels ont naturellement éprouvées à évaluer l'expansion économique dans

son ensemble, dans des secteurs individuels ou même dans leur secteur personnel du marché. Néanmoins, il est possible que de telles estimations influencent le développement du système d'enseignement. De même, il faut envisager les estimations de besoin national en matière de chercheurs (1) que de nombreux pays effectuent, telles que les estimations des "douze sages" publiées en France en 1969. Ces estimations des besoins nationaux en chercheurs jusqu'en 1980 définissaient "le nombre de chercheurs nécessaires afin d'utiliser de manière appropriée les fonds disponibles pour la recherche jusqu'en 1980" (tableau 6).

Compte tenu des facteurs démographiques, le Comité consultatif a ainsi calculé que 110.000 à 150.000 chercheurs nouveaux seraient nécessaires entre 1966 et 1980, dont 90.000 à 130.000 seraient des spécialistes des sciences pures. En outre, il estime qu'au moins deux chercheurs par groupe de six devraient être titulaires du doctorat. Cependant, en 1966 l'université n'a décerné que 951 doctorats de 3ème cycle et 689 doctorats d'Etat en sciences. La conclusion évidente est qu'une très forte expansion de la formation des chercheurs est impérative.

Dans un document où ils critiquent les méthodes de prévisions employées au Royaume-Uni par le Comité sur les ressources en main-d'oeuvre, K.G. Gannicott et M. Blaug l'ont accusé d'être un "lobby" pour le développement scientifique (2). Dans un sens, il l'est effectivement, car à une époque où l'on sait que le progrès est considéré comme étant nécessairement tributaire du rendement de la recherche, une telle position est l'inévitable conséquence de toute estimation du besoin national en matière de chercheurs.

Le "marché" des chercheurs

Les critiques de M. Blaug à l'égard du Comité sur les ressources en main-d'oeuvre du Royaume-Uni visent son incapacité à employer un concept de la demande qui soit fonction de facteurs économiques. Selon une formule appropriée pour l'économiste, la demande est un élément quantitatif qui n'a de sens que s'il est lié aux prix. Logiquement, une pénurie résultant du déséquilibre entre l'offre et la demande provoque une

(1) "La demande est définie par rapport à ... la bonne volonté et à l'aptitude des collectivités à verser les fonds nécessaires. Ainsi, par demande accrue d'enseignants qualifiés, il faut entendre que s'ils étaient plus nombreux, des postes d'enseignants leur seraient effectivement offerts".

Le besoin est défini par rapport aux objectifs énoncés d'une organisation ou d'une collectivité ..." (Comité du Royaume-Uni sur les ressources en main-d'oeuvre).

(2) G.K. Gannicott et M. Blaug : "Manpower Forecasting Since Robbins : A Science Lobby in Action". Higher Education Review, automne 1969 (Londres).

TABEAU 6

Estimations du nombre de chercheurs
nécessaire en France (1966-1980) en fonction
de trois hypothèses financières (1)

Dépenses brutes présumées pour 1980 en matière de recherche et de développe- ment	Nombre de chercheurs nécessaires et équivalents à plein temps en		
	1966	1970	1980
Hypothèse élevée (35 millions de FF)	Chercheurs Equivalents à plein temps	65.000	95.000
		45.000	130.000
Hypothèse moyenne (29 millions de FF)	Chercheurs Equivalents à plein temps	65.000	90.000
		45.000	120.000
Hypothèse basse (25 millions de FF)	Chercheurs Equivalents à plein temps	65.000	85.000
		45.000	60.000
			115.000
			80.000

(1) CCRST : "Prospective de la recherche scientifique et technique en France
(III, Problèmes des hommes et des chercheurs)" Progrès scientifique 128
(Paris 1969)

hausse des prix - dans ce cas des traitements - et en conséquence une augmentation de l'offre. Nous ne souhaitons pas contester la logique de ce raisonnement, mais son application à des situations réelles pose des problèmes aigus.

Aux Etats-Unis, de nombreux rapports sur la pénurie de chercheurs et d'ingénieurs publiés au cours des années cinquante (par le Comité consultatif scientifique du Président et par d'autres organismes) ont incité les économistes à tenter d'effectuer leur propre analyse au moyen de données définissant la situation du marché. En d'autres termes, des variables économiques négligées dans toutes les études relatives aux besoins ont été introduites dans l'analyse de ce problème.

Arrow et Capron (1) qui ont effectué une telle étude ont introduit le concept d'une "pénurie dynamique" pour décrire la spectaculaire expansion du marché des ingénieurs et des chercheurs aux Etats-Unis dans les années cinquante. Cette pénurie dynamique était essentiellement due à une demande en augmentation rapide, à un système d'enseignement libéral, et à une certaine rigidité du mécanisme de l'offre et de la demande. Bien que la situation soit aujourd'hui très différente, cette analyse est riche d'enseignement. En effet, étant donné la lenteur de la réaction du marché, et en particulier du système d'enseignement, on commettrait une erreur en tentant de modifier ce système de manière trop radicale, selon les évaluations actuelles des pénuries et des excédents. Cette lente réaction pourrait aisément se traduire par des réponses cycliques continuellement déphasées. La gravité de cette menace est de plus en plus largement reconnue : au Royaume-Uni, on considère en général que le rapport Willinck est un exemple d'une telle catastrophe (2).

Même si l'on utilise des données économiques, les interprétations diffèrent, et il serait imprudent de demander aux économistes d'avoir une vue omnisciente de la situation de la main-d'oeuvre. Ainsi, Blank et Stigler (3), analysant les traitements versés aux ingénieurs et aux chercheurs dans la période antérieure à 1955, sont parvenus à la conclusion qu'il n'existait pas de pénurie. Même pour la période 1950-1955, alors que l'existence d'une grave pénurie était proclamée presque partout, Blank et

(1) K.J. Arrow et W.M. Capron : "Shortages and Salaries : the Engineer-Scientist Case in the U.S.". (Republié dans Economics of Education, vol. I. ed. M. Blaug (Penguin).

(2) Ministry of Health : Report of the Committee to Consider the Future Numbers of Medical Practitioners and the Appropriate Intake of Medical Students (Londres, 1957). Ce rapport qui prévoyait, par erreur, un excédent de médecins s'est traduit par une réduction catastrophique du nombre des écoles de médecine.

(3) D.M. Blank et G.J. Stigler : The Demand and Supply of Scientific Personnel (New York, 1957).

Stigler ont estimé qu'il ne pourrait en être ainsi, étant donné la très faible hausse des traitements. Arrow et Capron (op. cit.), utilisant leur propre définition de la pénurie, ont conclu qu'elle existait effectivement pendant cette période et ont rejeté les arguments de Blank et Stigler.

Nous n'utilisons pas ces exemples pour contester que l'offre dépend des prix, car ce serait nier l'évidence. Toutefois, nous en faisons état pour démontrer la complexité de cette relation, de crainte que l'on y cherche une explication totale de l'expansion de la formation des chercheurs.

En résumé, il ne saurait y avoir de doute que les considérations relatives à la politique scientifique ont été extrêmement importantes pour stimuler le développement des études universitaires de 3ème cycle à orientation professionnelle dans le domaine des sciences pures. Manifestement, elles ont exercé une influence, à la fois en incitant les étudiants à opter pour une telle formation et en incitant les gouvernements à lui attribuer des ressources.

La situation ne peut manquer d'évoluer, car la science n'est plus considérée aujourd'hui comme une panacée universelle, et les fonds consacrés à la recherche commencent à baisser en valeur réelle. Les incidences précises de ces considérations, non pas sur l'allocation de ressources par les gouvernements (où elles sont déjà apparentes), mais sur le choix des étudiants, demeure une question qui fascine l'imagination mais à laquelle il est pour le moment impossible de répondre.

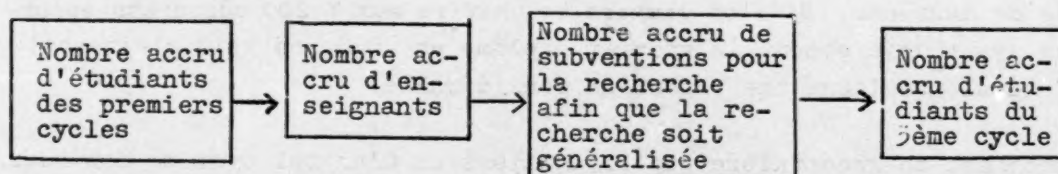
D. La dynamique du système de l'enseignement supérieur

Les études de 3ème cycle sont un élément essentiel du système de l'enseignement supérieur, tant en vertu de la contribution directe qu'elles apportent à l'effort de recherche de l'université, que parce qu'elles sont une partie essentielle de la préparation des futurs professeurs de l'enseignement supérieur. L'essor qu'elles ont pris au cours des récentes années peut donc être attribué à la fois au développement de la recherche universitaire et aux besoins prévus en matière de professeurs de faculté. Enfin, de nombreux établissements d'enseignement souhaitent élever leur prestige au sein du système, ce qui est également l'un des facteurs de ce développement.

Les études universitaires de 3ème cycle considérées comme des "frais généraux" de la recherche

A l'université, la recherche est effectuée par trois groupes de personnel diplômé : les membres de la faculté, les fellows (ou assistants de recherche) et les étudiants préparant le(s) doctorat(s). Toutefois, étant donné que dans la plupart des pays (autres que les Etats-Unis) les étudiants sont numériquement en majorité substantielle, et qu'ils consacrent une part importante de leur temps à la recherche (en moyenne 50 % environ) ils accomplissent manifestement la plus grande partie des travaux effectifs de recherche. Uniquement en termes de main-d'oeuvre (c'est-à-dire en prenant pour chaque groupe la main-d'oeuvre équivalente à plein temps), il n'est

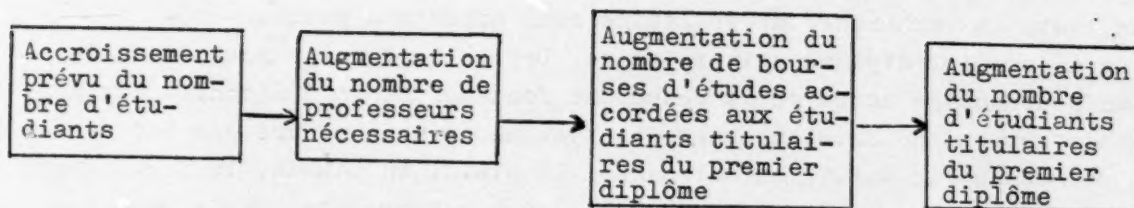
pas difficile de démontrer qu'au Royaume-Uni et au Canada, par exemple, les deux tiers environ de toute la recherche universitaire sont effectués par des étudiants titulaires du premier diplôme universitaire. Depuis quelques années, dans de nombreux pays, un pourcentage accru de la recherche fondamentale a été confié aux universités, en raison surtout du développement des systèmes mis en oeuvre par les conseils nationaux de la recherche (le D.F.G. en Allemagne, le N.R.C. au Canada, le N.S.F. aux Etats-Unis, le C.N.R.S. en France, etc), pour le soutien des projets. Des subventions de cette nature ont été utilisées pour financer les activités de chercheurs à titre temporaire, aux niveaux supérieurs au premier diplôme et au doctorat. Nous savons par exemple, qu'au Canada et aux Etats-Unis, les travaux d'environ 40 % des étudiants préparant le doctorat en sciences pures sont financés au titre des subventions de recherche octroyées aux chercheurs confirmés. En Allemagne, un pourcentage appréciable des candidats au doctorat reçoivent probablement des subventions du D.F.G, et en France de nombreux étudiants préparent leur thèse dans les laboratoires du C.N.R.S. ou des laboratoires qui en dépendent. En d'autres termes, le développement de la préparation à la recherche a été en partie un effet secondaire presque accidentel de l'expansion scientifique au sein des universités plutôt que le résultat d'une politique délibérée de l'enseignement. La logique inexorable des événements, depuis quelques années, peut être illustrée comme suit :



Bien entendu, il en a été particulièrement ainsi dans les pays où la recherche universitaire s'est développée le plus rapidement, en réponse aussi au désir des gouvernements et de l'industrie de confier sous contrat leurs travaux de recherche fondamentale aux universités.

Les besoins en professeurs d'universités

Dans tous les pays qui ont institué des études universitaires de 3ème cycle elles sont considérées comme un élément essentiel de la formation des professeurs de faculté. (Dans les autres, elles sont remplacées par un stage en tant qu'assistant d'un professeur, pour l'enseignement ou la recherche). En Amérique du Nord, on ne peut obtenir un poste dans une université sans diplôme de Ph. D., en France le doctorat d'Etat et en Allemagne l'Habilitation sont exigés. En U.R.S.S. également, l'Aspirantura, que les étudiants préparent après avoir satisfait à des critères de sélection assez rigoureux, est considéré comme le mode essentiel de formation du corps enseignant universitaire. Ainsi, le développement prévu du système d'enseignement supérieur qui exige le recrutement d'un plus grand nombre d'enseignants, exige en même temps un nombre accru d'élèves-professeurs. La seconde loi de la dynamique du développement des études universitaires de 3ème cycle peut être illustrée comme suit :



La politique actuelle de la République fédérale d'Allemagne en matière d'enseignement supérieur est un exemple d'une politique de cette nature. Estimant que la population universitaire actuelle qui est de 440.000 étudiants, augmentera de plus du double dans les dix prochaines années, le Ministère fédéral a conclu qu'il était essentiel d'adopter une politique destinée à assurer un large accroissement du nombre de professeurs d'université. Un programme de soutien des étudiants poursuivant des études universitaires de 3ème cycle (Graduierten-programm) sera mis en oeuvre en 1971. Les étudiants qui ont passé les examens de promotion qui leur donnent accès aux études préparatoires au doctorat pourront bénéficier de ce programme - 5.000 bourses de cette nature seront octroyées en 1971 et 10.000 bourses nouvelles chaque année suivante. Ainsi, en 1974, 20.000 étudiants bénéficieront de bourses d'études d'une durée de deux ans. Si l'on compare ce chiffre aux 7.200 doctorats accordés à des étudiants ayant déjà obtenu le premier diplôme en 1966, on voit clairement que la République fédérale envisage une expansion considérable.

Il est important de reconnaître que la réalisation d'un tel système demandera de longs délais. Le calcul des besoins, l'octroi des bourses, le recrutement d'un plus grand nombre d'étudiants s'orientant vers la recherche ne constituent que les premiers stades du processus. Peut-être faudra-t-il jusqu'à cinq à sept ans avant que les nouveaux étudiants obtiennent leur doctorat. Le soutien accordé par des sources officielles aux étudiants se destinant à la recherche, qui leur permettra de concentrer tous leurs efforts sur leurs études aura peut-être un important effet secondaire, à savoir une réduction du temps nécessaire pour obtenir le diplôme de doctorat.

Evolution institutionnelle

La "loi" finale de la dynamique de l'enseignement supérieur est, pourrait-on dire, celle qui règle le processus par lequel les institutions universitaires s'efforcent de rehausser leur statut - ou ce qu'elles considèrent comme tel. Dans les pays comme le Royaume-Uni, où une distinction officielle est établie entre l'enseignement supérieur universitaire et non universitaire, le secteur non universitaire pourrait être amené à tenter de conquérir les attributs du secteur universitaire parmi lesquels les études de 3ème cycle occupent une place prépondérante. Un processus analogue que l'on observe depuis quelque temps aux Etats-Unis se manifeste sous la forme d'une tendance accrue, de la part des collèges de culture générale, à décerner des diplômes supérieurs. D'après un récent rapport du National Science Board (1), pendant les

(1) National Science Board : Graduate Education - Parameters for Public Policy (Washington, 1969).

années 1955/56 à 1965/66, le nombre d'établissements offrant un doctorat a augmenté d'environ 6,5 % en moyenne par an. Au niveau du Master's Degree la situation a évolué plus rapidement encore, car les Liberal Arts Colleges ont institué des cours sanctionnés par ce grade, et d'autres établissements ont mis en place des cours de doctorat.

Bien que nous n'ayons guère d'informations sur ce processus d'évolution institutionnelle, il est, semble-t-il, à la fois normal et largement répandu (1). De ce fait, il constitue aussi une contribution importante au développement des études universitaires de 3ème cycle. Cette tendance a manifestement d'importantes implications pour tous ceux qui s'efforcent de prendre des mesures qui provoquent une augmentation rapide du nombre d'étudiants.

V. QUELQUES QUESTIONS D'ACTUALITE

A. Comment les études universitaires de 3ème cycle devraient-elles être organisées ?

Nous avons souligné plus haut que dans tous les pays qui n'en ont pas encore institué, on constate une forte propension vers la création d'un diplôme "professionnel" du type Ph.D en sciences pures. Cependant, là où ces diplômes existent, il y a eu contestation (explicite ou implicite) au sujet de l'importance relative à attacher aux considérations professionnelles d'une part, et aux considérations didactiques de l'autre. Les considérations professionnelles - impliquant que l'étudiant reçoive une formation de recherche scientifique - prédominent dans le domaine des sciences pures au Canada, au Royaume-Uni et aux Etats-Unis. Bien entendu, les pays qui offrent un doctorat non professionnel sont enclins à adopter l'attitude opposée. Le problème ne se pose pas seulement sur le plan philosophique, il a d'importantes implications : en premier lieu, sur l'organisation des études, puis sur l'opportunité d'encourager les étudiants à préparer leurs diplômes supérieurs en dehors de l'université, enfin sur les modalités optimum de soutien financier des études de 3ème cycle par les gouvernements (en tant qu'extension de l'enseignement supérieur proprement dit ou de "frais généraux" relatifs à la recherche). Ceci a incontestablement des incidences sur la politique de l'emploi et de la main-d'oeuvre ; il semble que l'obtention du doctorat professionnel donne implicitement l'accès à une carrière de chercheur. Les deux premiers points sont examinés ci-dessous ; le financement et l'emploi le seront ultérieurement.

Les problèmes qui se posent concernent particulièrement les études universitaires du 3ème cycle et la formation en sciences pures ; c'est dans ce contexte que les difficultés sont les plus aiguës. Cependant, il ne faut pas conclure que d'autres domaines en sont totalement exempts ; il semble plus que probable que si l'explosion actuelle au niveau des quatre premières années d'enseignement des sciences sociales provoque demain une explosion au niveau du 3ème cycle, des difficultés analogues surgiront.

(1) Sauf peut-être au Japon. Le Rapport préliminaire du Comité permanent des études universitaires de 3ème cycle de l'Association des universités nationales s'efforce d'encourager les travaux de recherche et les études universitaires de 3ème cycle dans les petites universités, et non pas - comme dans certains pays - de les décourager.

Dans la plupart des pays, les responsables de la politique scientifique conçoivent les travaux au niveau du doctorat comme une activité professionnelle ; ils reconnaissent que les étudiants apportent une contribution extrêmement importante à la recherche universitaire, mais ils se sont peut-être moins préoccupés jusqu'ici de la contribution que celle-ci apporte en contrepartie à l'enseignement. Ainsi, il est fréquent que le rôle didactique de la recherche universitaire ne soit pas suffisamment pris en considération dans la politique adoptée en la matière. Par exemple, les responsables de la politique scientifique sont souvent convaincus que les grands groupes de recherche ont un meilleur rendement que les groupes réduits. En revanche, de nombreux universitaires estiment que la recherche effectuée au sein d'un groupe important crée un climat moins favorable à l'enseignement que la recherche par petits groupes. Des politiques visant à concentrer les ressources, à créer de grands "centres d'excellence" sont en voie d'application, en raison de leurs avantages potentiels pour l'efficacité de la recherche ; les incidences sur le processus didactique sont laissées au deuxième plan.

"En Europe, de nombreuses unités de recherche sont trop réduites pour être viables et leur concentration en quelques grandes unités améliorerait le rendement de la recherche". La République fédérale d'Allemagne et le Royaume-Uni sont les principaux protagonistes de ce principe. En République fédérale, le Wissenschaftsrat établit une liste des domaines de recherche spécifique (Sonderforschungsbereiche) dans lesquels une telle politique de concentration doit être appliquée. Des fonds spéciaux sont fournis par le D.F.G. (1), et la procédure a été élargie à une gamme étendue de projets en lettres, en sciences sociales, en sciences pures et en sciences appliquées. Au Royaume-Uni, le Science Research Council commence à appliquer une politique assez analogue dont un document publié récemment expose les bases (2). Certains domaines recevront un soutien financier spécial " en fonction des résultats de l'examen des possibilités spéciales qu'ils peuvent offrir pour le progrès de la science fondamentale, ou en raison de leur valeur sur le plan économique ou communautaire".

"Un nombre limité de départements universitaires recevront un soutien supérieur à la moyenne, pour leur permettre de concentrer leurs efforts dans des domaines sélectionnés ; ces départements seront choisis en fonction de leur haute autorité, de leurs réalisations passées, de leurs compétences actuelles ou d'autres facteurs déterminants (par exemple en fonction de leur aptitude à coopérer avec l'industrie)."

La concentration de l'enseignement de la recherche est ainsi réalisée sans que l'on ait particulièrement pesé - ou même prêté beaucoup d'attention aux incidences didactiques de la politique adoptée.

Ce dilemme parmi d'autres que pose la politique relative aux études de 3ème cycle est une conséquence des avantages concurrents des perspectives purement professionnelles et des perspectives de caractère plus universitaire. L'importance à attacher

(1) Voir D.F.G.: Bericht (1969) pp. 72-79, (Bad Godesberg 1970).

(2) S.R.C.: Selectivity and Concentration in Support of Research (Londres 1970).

à l'enseignement magistral dans le cadre de la formation et de l'instruction des chercheurs pose un autre problème analogue. Les méthodes pratiquées diffèrent sensiblement selon les pays :

Canada } Etats-Unis }	50 % environ des études préparatoires au <u>Ph.D</u> consistent en séminaires, conférences, etc.
Royaume-Uni	Certains cours magistraux obligatoires sont prévus dans la majorité des départements de chimie et de physique - mais pas dans les départements de biologie.
Allemagne	Pratiquement aucun cours magistral n'est prévu et aucun de ceux qui existent n'est obligatoire.
Norvège	Environ un tiers du temps de préparation <u>Cand. Real.</u> est consacré aux études supérieures avancées. Pas d'enseignement magistral pour la préparation au doctorat.
France	La première année des travaux préparatoires au doctorat du troisième cycle est entièrement consacrée à des études supérieures conduisant au diplôme d'études avancées (D.E.A.).

En revanche, il faut ajouter que les responsables de la politique scientifique et les milieux universitaires reconnaissent sans exception qu'il est important de conférer un caractère magistral aux études supérieures. Au Royaume-Uni, les cours obligatoires deviennent de plus en plus nombreux ; en Allemagne, où ces cours n'existaient pas, les pouvoirs publics considèrent que c'est l'une des graves lacunes de l'enseignement supérieur. Toutefois, si les cours magistraux ont des exigences excessives, ils risquent de ne pas laisser aux étudiants de temps libre pour la recherche. Bien que cela ne semble pas être le cas dans les pays de l'OCDE, il en est ainsi, par exemple, en URSS. Les étudiants préparant leur Aspirantura sont censés consacrer principalement les deux premières années à des études de base ainsi qu'à l'enseignement (en tant que contribution à leur formation pédagogique). De plus en plus, la troisième année consacrée à la recherche est jugée insuffisante pour assurer la formation dans ce domaine, si bien que la présentation des thèses est souvent retardée (1).

L'enseignement de la recherche pose un autre problème qu'il convient d'examiner ici : faut-il autoriser (ou encourager) les étudiants à effectuer des recherches dans des laboratoires industriels ou gouvernementaux ? De nombreux responsables de la politique scientifique considèrent cette possibilité comme un moyen important de resserrer les liens entre l'université et l'industrie. Les titulaires de Ph.D qui ont effectué des recherches au cours de leurs études universitaires de 3ème cycle, dans un milieu "d'utilisateurs" pourront être beaucoup plus utilement employés par la suite, disent certains.

(1) Politiques nationales de la science : U.R.S.S., OCDE (Paris 1969) p. 348.

Les gardiens des normes universitaires estiment au contraire que la recherche faite extra-muros risque d'avoir une valeur didactique contestable : les industriels qui contrôleront ces travaux ne seront guère disposés à dispenser un enseignement réel et peut-être guère capables de le faire. Dans quelle mesure cette méthode d'enseignement de la recherche est-elle appliquée ?

Etats-Unis : couramment dans les laboratoires gouvernementaux et industriels ; les règlements sont différents selon les universités ;

Allemagne : couramment ;

Royaume-Uni : rarement ; de nombreuses universités autorisent les étudiants à effectuer des recherches dans certains laboratoires spécifiés, en général sous surveillance commune. En outre, les diplômes de Ph.D. décernés par le C.N.A.A. (1) sont offerts aux candidats employés dans l'industrie ;

Canada : rarement : un très petit nombre d'universités autorisent les étudiants à fréquenter certains établissements gouvernementaux ;

Norvège : couramment dans les instituts du N.T.N.F. mais inconnue dans les industries ;

France : couramment mais dans les laboratoires du C.N.R.S., essentiellement.

Comme nous l'avons dit plus haut, le fait d'encourager les étudiants à travailler pour la préparation des diplômes supérieurs en dehors de l'université est considéré comme un moyen d'améliorer les relations entre l'université et l'industrie ou l'industrie et le gouvernement ; ceci est probablement une erreur : il semblerait que si les étudiants sont encouragés à procéder ainsi, ce serait plutôt en raison des bonnes relations qui ont déjà été établies.

L'organisation des études universitaires de 3ème cycle doit être déterminée par leurs fonctions. Peut-être faudra-t-il organiser un doctorat professionnel en sciences tout autrement qu'un doctorat non professionnel en sciences humaines, les cours obligatoires et le contrôle universitaire étant entièrement différents. Bien qu'un certain enseignement magistral semble être nécessaire dans l'un et l'autre cas, la

(1) C.N.A.A. ou Council for National Academic Awards. Organisme autonome établi en 1964, pour décerner des diplômes aux étudiants en dehors des universités. Le Conseil décerne ces diplômes à tous les niveaux et a octroyé en 1968/69 environ 60 diplômes de Ph.D.

nature exacte et l'ampleur de cet enseignement sont des questions qui ne peuvent être laissées au hasard. La formation à la recherche peut être assortie soit d'un enseignement magistral insuffisant (comme dans de nombreux pays de l'OCDE), soit d'un enseignement excessif (comme en URSS) - ce double risque est très réel.

B. Le financement des études universitaires du 3ème cycle

Le financement des études de 3ème cycle par les gouvernements, qui est lié à la question de l'organisation de ces études, exposée plus haut, est incontestablement, en principe, l'un des principaux moyens de contrôle - en admettant qu'un tel contrôle soit souhaité - du nombre et du rendement des étudiants poursuivant leurs études au-delà du premier diplôme. Dans de nombreux pays, les crédits prévus par les pouvoirs publics pour le soutien des étudiants préparant des diplômes supérieurs ont très fortement augmenté au cours des récentes années, mais ces mesures ont été dans l'ensemble limitées aux sciences pures (1), et elles ont été pour une grande part un effet secondaire du développement de la recherche universitaire. La conséquence en a été un développement des études de 3ème cycle (donc de la "production" de personnel de recherche) entièrement dissocié de toute politique spécifique en matière d'enseignement ou de main-d'oeuvre. Cette question est d'une extrême importance, étant donné surtout les violentes fluctuations qui sont maintenant prévisibles en matière de fonds consacrés à la recherche, ici encore en l'absence de tout examen approprié de leurs incidences didactiques. La valeur relative des systèmes de bourses et de prêts accordés pour financer la poursuite des études de 3ème cycle pose également une question importante. Dans quelle mesure le financement des étudiants - considérés (du point de vue administratif) comme une main-d'oeuvre peu coûteuse - est-il un produit secondaire de la recherche ? En revanche, dans quelle mesure sont-ils financés sur les fonds destinés à l'enseignement ? En pratique, les divers types de fonds de soutien fournis par les gouvernements sont les suivants :

- (a) Bourses d'études de recherche (prêts) accordées par les ministères de l'éducation (ou leurs équivalents) (2).
- (b) Bourses de perfectionnement d'études accordées par les Conseils de la recherche.

(1) Ainsi, aux Etats-Unis, en 1969, dans les départements du niveau du doctorat, 47 % des étudiants en sciences physiques et 21,5 % des étudiants en sciences sociales ont été supportés financièrement par le Gouvernement fédéral : Graduate Student Support and Manpower Resources in Graduate Science Education, N.S.F. 70-40, page 49. Les proportions sont certainement beaucoup plus faibles encore pour les sciences sociales et humaines.

(2) Nous excluons de cette catégorie les étudiants auxquels les universités accordent des bourses sur les fonds que les ministères de l'éducation leur octroient pour leurs dépenses de fonctionnement normales (c'est-à-dire le financement indirect).

(c) Bourses d'assistants de recherche dans le cadre des subventions octroyées par les Conseils de recherche (1) aux chercheurs universitaires.

Bourses d'assistants de recherche dans le cadre des contrats passés par les ministères aux chercheurs universitaires.

TABEAU 7

Ampleur approximative et type du soutien gouvernemental accordé aux étudiants en sciences effectuant des recherches en 1968/69
(dans quelques pays sélectionnés seulement)

	Pourcentages			Total de l'effectif des étudiants exécutant des recherches (Sciences)
	Sur les fonds de l'enseignement	Sur les programmes de bourses d'études et de perfectionnement des organismes de recherche	A titre d'assistants de recherche	
Canada	0	30-35 (Conseil national de la recherche)	15-20	5.500
France	25 (M.E.N.)	0	n.d.	18.800 /
Allemagne	(Après 1971 environ 50)	0	n.d.	3-4.000
Norvège	50	10-15 (Conseils de la recherche)	10-15	500
Royaume-Uni	5	55 (Conseils de la recherche)	5	12.500 (temps complet seulement)
Etats-Unis*	5 (NDEA)	15	15	100.500

* Départements accordant des diplômes de Ph.D. seulement
5 (gouvernement central et local)

n.d. : données non disponibles
/ : y compris le doctorat d'Etat (1966/67)

Dans le tableau 7, nous nous sommes efforcés de répartir le soutien accordé aux chercheurs par les gouvernements des divers pays en trois catégories selon la classification figurant plus haut. Dans la section suivante, nous essayons de mettre en lumière les avantages et les faiblesses inhérents aux divers systèmes.

(1) Par Conseils de la recherche, nous entendons les organismes nationaux dont l'une des principales fonctions est le soutien de la recherche universitaire : N.R.C. (Canada), C.N.R.S. (France), D.F.G. (Allemagne), N.A.V.F./N.T.N.F. (Norvège), S.R.C., etc. (Royaume-Uni), N.S.F. (Etats-Unis).

Au Canada, au Royaume-Uni et aux Etats-Unis des pourcentages très importants d'étudiants sont financés de manière différente, à partir de sources gouvernementales scientifiques.

Dans ces pays, le diplôme de Ph.D. a un caractère essentiellement professionnel (nous examinons plus loin le financement des grades de recherche non professionnels). Est-il possible de souligner les avantages et les inconvénients spécifiques dérivant du financement de l'aide aux étudiants de 3ème cycle principalement au titre d'un (ou de plusieurs) programme(s) de bourses de perfectionnement, ou en tant que produit secondaire d'un contrat de recherche ? Dans le premier cas, on peut planifier le soutien accordé par des bourses de perfectionnement en fonction des besoins en main-d'oeuvre scientifique (si l'on peut les établir). En d'autres termes, on peut déterminer le nombre global de bourses à octroyer, ainsi que l'équilibre à établir entre les diverses disciplines scientifiques. Bien entendu, le nombre total de chercheurs formés dans un nombre donné d'années ne peut être strictement contrôlé, en partie parce que des fonds de soutien des étudiants sont également fournis par des sources non gouvernementales. Toutefois, un système de soutien essentiellement concentré dans un programme de bourses de perfectionnement administré par les Conseils de la recherche semble offrir les meilleurs moyens pour le contrôle de la production de chercheurs.

En revanche, il faut reconnaître que le concours des assistants de recherche est dû pour une très grande part à l'existence de relations particulièrement étroites entre l'université et les utilisateurs des diplômes. En d'autres termes, il se peut que ce mode de financement des études ne permette pas de limiter aisément (si on le souhaite) la production de titulaires de Ph.D. - mais il renforce la valeur du système de recherche. Du point de vue de l'étudiant, il s'ensuivra probablement une prolongation de la période de formation. La situation aux Etats-Unis semble être sur le point d'évoluer. L'amendement Mansfield et les réductions des crédits fédéraux de recherche et de développement se traduiront sans doute par une concentration relativement plus forte du soutien accordé aux étudiants : le N.S.F., par exemple compensera dans une certaine mesure les réductions apportées ailleurs, et le soutien octroyé sous forme de subventions augmentera aux dépens des bourses de perfectionnement.

La situation actuelle, aux Etats-Unis comme au Royaume-Uni, est la conséquence des méthodes adoptées par les gouvernements respectifs de ces pays pour le financement de l'enseignement préparatoire au doctorat à **orientation** professionnelle, en sciences et en technologie. L'une de ces conceptions, qui est pluraliste, résulte des relations étroites qui se sont engagées entre les organismes de recherche appliquée et les universités, ainsi que les immenses besoins qui se sont manifestés aux Etats-Unis en matière de recherche et de chercheurs. Le système britannique, plus centralisé, reflète par son ampleur le voeu du gouvernement britannique, au cours des récentes années, de restreindre la production de titulaires de diplômes scientifiques au niveau du Ph.D. Dans les pays où l'enseignement préparatoire au doctorat (ou son équivalent approximatif) est non professionnel, les procédures de financement adoptées par les gouvernements tendent à être légèrement différentes. Les études au niveau du doctorat en République fédérale d'Allemagne, et les études préparatoires au grade de Cand.Real. en Norvège en sont un exemple.

En Allemagne, le Conseil de la recherche (D.F.G.) n'est pas habilité à donner une aide financière aux étudiants préparant leur thèse de doctorat. Certains d'entre eux, il est vrai, sont rémunérés sur les subventions de recherche du D.F.G. à titre d'assistants de recherche, mais le simple fait que le D.F.G. n'ait pas établi de statistiques sur leur nombre témoigne du peu d'intérêt qu'il porte à la question. Jusqu'en 1970, il n'existait pas de programmes fédéraux pour le soutien spécifique de la préparation au doctorat, bien que quelques-uns des étudiants ainsi promus aient certainement reçu un soutien au titre du programme Honnef de financement général des études universitaires (1). En outre, certains étudiants - et peut-être sont-ils très nombreux - sont subventionnés par des fonds du Bund et des Länder en tant que professeurs-assistants dans les universités. Ici encore, aucune statistique n'a été établie sur leur nombre. En 1970, le Gouvernement fédéral a annoncé qu'il adoptait une nouvelle politique, aux termes de laquelle il octroierait (par l'intermédiaire des universités) un très grand nombre de bourses de recherche pour les études de 3ème cycle (le programme Graduerten-Förderung).

Ces bourses de recherche sont prélevées sur le budget de l'enseignement et non pas sur celui de la recherche, car les prévisions indiquent que le nombre de professeurs de l'enseignement supérieur sera insuffisant pour répondre aux besoins des étudiants, au nombre d'un million, prévus pour 1980. En d'autres termes, le Gouvernement fédéral se préoccupe maintenant de former des professeurs d'université.

En Norvège, la situation au niveau préparatoire au Cand. Real. est différente. Pour aider les étudiants à ce niveau, l'Etat utilise principalement un système de prêts. Aucune distinction n'est faite entre le financement des études à ce niveau et aux niveaux précédents. Environ 50 % des étudiants préparant le Cand. Real. reçoivent des prêts ; les autres dans l'ensemble financent leurs études par leurs propres moyens. Un programme de soutien des étudiants qui était appliqué par le Conseil de la recherche (N.A.V.F.) a été réduit à une moyenne annuelle de vingt-cinq étudiants - principalement des étudiants en médecine.

La République fédérale d'Allemagne et la Norvège offrent donc deux exemples des méthodes adoptées par les gouvernements pour le financement des doctorats non professionnels. En Allemagne, le climat de "laissez-faire" qui régnait est sur le point d'être radicalement modifié par une intervention fédérale de grande envergure, motivée par la pénurie prévue en personnel universitaire. Dans une certaine mesure, l'Allemagne s'oriente donc vers un doctorat de caractère plus professionnel. En Norvège, où le gouvernement applique un système de prêts (par opposition aux subventions qui seront octroyées en Allemagne), rien n'indique qu'il ait l'intention de relever le niveau du diplôme de Cand. Real. Ce système de prêts répond réellement à la demande sociale : tous ceux qui souhaitent accéder à l'enseignement du 3ème cycle peuvent le faire, du moins en

(1) La Fondation Volkswagen est peut-être le seul organisme qui ait une politique spécifique en matière d'études universitaires de 3ème cycle - et en particulier de soutien accordé aux étudiants dans les nouveaux domaines interdisciplinaires, pour les inciter à compléter leurs premiers diplômes par des études plus poussées dans un domaine nouveau. Voir F. Gebhardt : Promotion und Stipendium (Göttingen 1967) ; cependant, cette question dépasse légèrement notre examen des politiques gouvernementales.

principe. Cependant, les économistes spécialisés en matière d'enseignement (1) se sont longuement demandé s'il est possible de formuler des jugements normatifs sur l'opportunité d'accorder des prêts ou des subventions et nous n'examinerons pas cette question ici. Peut-être, cependant, l'orientation vers les professions exigeant un niveau donné d'enseignement a-t-elle d'importantes incidences sur le choix de la méthode de financement appropriée. Les protagonistes du système de financement par prêts, au Royaume-Uni, par exemple, ont parfois fait valoir que c'est au niveau des études universitaires de 3ème cycle qu'il convient d'entreprendre l'introduction d'un tel programme. Il est vrai que l'un des principaux arguments avancés en faveur des subventions au cours des quatre premières années d'études - à savoir qu'elles favorisent la participation des étudiants appartenant aux milieux ouvriers - est sans valeur ici. En revanche, l'enseignement professionnel au niveau des études universitaires de 3ème cycle pourrait avoir des effets externes particulièrement importants qui iraient à l'encontre de l'argument basé sur le fonctionnement du marché.

C. Quelques problèmes de l'emploi

Au Canada, au Royaume-Uni et aux Etats-Unis, le Ph.D. ès sciences est considéré (tout au moins initialement) comme une préparation à une carrière de recherche. Les titulaires de ce diplôme sont rarement disposés à accepter d'autres emplois et le prestige dont se pare le doctorat s'est traduit (au Royaume-Uni, en particulier) par un drainage des étudiants les plus brillants vers les carrières autres que l'enseignement. Lorsqu'ils ont obtenu leur Ph.D. ès sciences, les diplômés sont enclins à penser qu'un poste de chercheur leur revient de droit. Nombreux sont ceux qui pensent que le Ph.D. est une médiocre préparation à toute autre carrière, ce qui ne peut manquer de susciter des préoccupations, à une époque où les fonds consacrés à la recherche vont en s'amenuisant. Examinons tout d'abord, la situation réelle de l'emploi de ceux qui ont obtenu le diplôme de Ph.D. anglo-américain "professionnalisé". Que font-ils ? Les données recueillies au Royaume-Uni peuvent être utilisées pour répondre à cette question. Au cours de l'année universitaire 1968/69, des diplômes supérieurs en sciences pures ont été décernés à 3.716 étudiants (65 % de doctorats) et à 414 étudiantes (55 % de doctorats) (2).

(1) Voir, par exemple Harris, S.E. : Higher-Education :

- Resources and Finance (McGraw-Hill 1962), chap. 17-22.
- Peacock A.T. and Wiseman J. : Education for Democrats (Institute for Economic Affairs, Londres 1964).
- Blaug M. : Introduction for the Economics of Education (Londres 1970), chap. 10.

(2) Premier emploi. Les données ultérieures concernent tous les titulaires de grades supérieurs. On ne dispose pas de chiffres distincts pour les titulaires de Ph.D.

TABLEAU 8

Premier emploi des titulaires de diplômes supérieurs en sciences
(Royaume-Uni, 1969)

Nombre de diplômes décernés	Enseignement scientifique plus poussé ou bourses de recherche postérieures au doctorat	Occupant un emploi au Royaume-Uni		
		Total	Recherche scienti- fique	Autres types d'activités de R-D
TOTAL DES ETUDIANTS EN SCIENCES				
Etudiants 3.716	925	1.306	583	210
Etudiantes 414	86	145	59	21
Total 4.130	1.011	1.451	642	231
CHIMIE 1.235	379	463	269	69
PHYSIQUE 795	155	274	133	49

En d'autres termes, nous pouvons dire qu'au Royaume-Uni environ un quart de tous les titulaires de diplômes supérieurs poursuivent leurs études de recherche dans les universités, et qu'un tiers à peu près (dont la moitié s'engage dans des recherches) prennent un emploi. Un sixième seulement de tous les titulaires de diplômes supérieurs effectue donc des recherches scientifiques dans un emploi productif. Ce sont des considérations comme celles-ci qui ont récemment conduit les auteurs britanniques de rapports sur la main-d'oeuvre scientifique à recommander que le pourcentage des diplômés s'orientant vers une formation de chercheurs aille en décroissant (1). La politique actuelle du Science Research Council, par exemple, consiste à s'efforcer de réduire ce pourcentage.

Au Royaume-Uni comme aux Etats-Unis, il n'y a aucun indice de chômage réel au niveau des Ph.D. au moment de l'octroi du diplôme. Au Royaume-Uni, les statistiques de l'University Grants Committee (U.G.C.) indiquent que le pourcentage de détenteurs de diplômes supérieurs qui n'ont pas encore obtenu un emploi permanent au 31 décembre de l'année de leur titularisation est minime. En 1969, par exemple, 46/3.716 (1,2 %) seulement des étudiants et 8/414 (2 %) des étudiantes ayant obtenu des diplômes supérieurs en sciences pures n'avaient pas trouvé de débouché. Aux Etats-Unis, d'après une étude du National Research Council (2) sur l'année 1969, 1,1 % des titulaires de Ph.D. étaient

(1) C.M.R. : The Flow into Employment of Scientists, Engineers and Technologists (Cmnd. 3.760, H.M.S.O. 1968).

(2) L.R. Harmon et al : "Employment Status of Recent Recipients of the Doctorate", in Sciences, 22/5/1970, p.930.

sans emploi (sans aucune différence appréciable entre les disciplines scientifiques), et 0,7 % avaient accepté des postes ne correspondant pas à la discipline qu'ils avaient choisie. Cependant, il y a tout lieu de penser que dans ces deux pays, comme au Canada, la situation de l'emploi est loin d'être satisfaisante pour les chercheurs spécialisés ou non récemment formés. En premier lieu, les chefs des départements scientifiques ont indiqué (au Royaume-Uni comme aux Etats-Unis) que les étudiants qui obtiennent leur Ph.D. éprouvent beaucoup plus de difficultés qu'il y a quelques années à trouver des débouchés appropriés. En second lieu, il semble probable que plusieurs d'entre eux acceptent des postes qui, tout récemment encore, auraient pu être remplis par des personnes non titulaires du Ph.D. Parmi ceux qui accèdent à des postes de recherche, très nombreux sont ceux qui occupent des fonctions de niveau post-doctoral. Ce phénomène mérite de retenir tout particulièrement l'attention.

Emploi non économique (ou chômage dissimulé)

L'expression "emploi non économique" que nous utilisons pour décrire une situation de l'emploi qui s'est créée depuis quelques années définit l'accès d'un grand nombre de titulaires de doctorats à des bourses de perfectionnement temporaires pour la recherche, ce qui ne représente pas une augmentation réelle de la demande. Le plein emploi (c'est-à-dire l'absence de chômage) des diplômés spécialisés dans la recherche est en apparence assuré, mais il ne s'agit que d'un sursis de la crise car, en général, le nombre de postes permanents n'a pas augmenté parallèlement. En outre, au niveau postérieur au doctorat, les possibilités de réaffectation sont encore plus réduites. Cette situation s'est créée depuis quelques années, mais nous ignorons dans combien de pays. Pour les Etats-Unis, elle se reflète dans les chiffres ci-après :

TABEAU 9

Pourcentage de titulaires du Ph.D. acceptant
des bourses de perfectionnement temporaires en
sciences pures, appliquées et sociales, (Etats-Unis)

	1958	1960	1965	1966	1967	1968	1969
Toutes les disciplines scientifiques	4,5	9,6	14,9	14,9	15,7	15,4	19,3
(Chimie)	(6,5)	(15,5)	(27,8)	(26,6)	(29,1)	(28,8)	(32,9)

La tendance de la situation à s'aggraver se manifeste par les chiffres relatifs à toutes les disciplines scientifiques, mais elle est plus particulière aux sciences fondamentales (la physique et la biologie évoluent en effet de manière analogue à la chimie). Ces fellows (étudiants diplômés) temporaires jouent un rôle dont on ne saurait nier l'importance dans l'exécution des recherches universitaires ; lorsque leur concours fait défaut, il est fréquent que le développement des nouvelles disciplines marque un temps mort, toutefois, l'inflation de la demande, créée par l'existence de tels postes, ne doit pas être interprétée comme une augmentation de la demande réelle. Le nombre de bourses de perfectionnement est certainement sujet à des fluctuations beaucoup plus fortes que ne le serait toute demande réelle de compétences de cette nature. Une telle inflation

pourrait fort bien perturber l'équilibre réel de l'offre et de la demande.

Nous pouvons dire que dans tous les pays examinés ici, qui délivrent des doctorats à orientation professionnelle (c'est-à-dire où la formation des chercheurs est essentiellement la prérogative des universités), il existe une crise de l'emploi des titulaires de ces diplômes - il en est ainsi au Canada, au Royaume-Uni et aux Etats-Unis. Bien que cette situation soit dans une certaine mesure due à des coïncidences, elle résulte aussi dans une certaine mesure des espérances d'une carrière de recherche qui sont associées au grade de Ph.D. Les vues du Comité Swann à ce sujet sont intéressantes :

"... nous pensons que le prestige attaché au cours de Ph.D. et la perspective de porter le titre de docteur attire presque certainement vers la recherche universitaire certains étudiants qui pourraient sans cela s'orienter utilement vers d'autres carrières ; de ce fait, il est, à notre avis, regrettable qu'un doctorat - avec tout ce que ce titre implique de prestigieux dans le monde universitaire (et jusqu'à un certain point en dehors de ces milieux) ne puisse être obtenu que d'une seule manière, c'est-à-dire à la suite de trois années de recherches, normalement effectuées à titre personnel, dans une université" (1)

Si des postes universitaires ne leur sont pas offerts, il est évident que les docteurs trouvent d'autres emplois - le faible taux de chômage en est la preuve. Cependant, quelle est la valeur exacte de leur grade de Ph.D. lorsqu'ils s'orientent, par exemple, vers l'industrie ? Ce problème a évidemment préoccupé de nombreux responsables de la politique scientifique, surtout, peut-être, au Royaume-Uni et au Canada.

A cet égard, l'opinion est loin d'être unanime dans l'industrie. De nombreux industriels se déclarent satisfaits des services des docteurs qu'ils emploient - peut-être, et dans certains cas presque certainement - en raison du critère de qualité qu'est le Ph.D. Les industriels veulent recruter un personnel d'élite - et quel est l'employeur qui ne le souhaite pas ? Or, pour eux, le Ph.D. donne une garantie de qualité. Dans d'autres cas, si les employeurs industriels se déclarent satisfaits, c'est manifestement en raison d'un rapport plus fondamental, c'est-à-dire, de l'intégration effective des activités de recherche (auxquelles les Ph.D. sont formés) dans le processus de production de l'entreprise. En revanche, de nombreux industriels sont manifestement mécontents des titulaires de Ph.D. en sciences et en technologie qu'ils emploient : à leur avis, les détenteurs de ces diplômes ont des intérêts trop étroits et ne peuvent communiquer en dehors du laboratoire. En conséquence, le diplôme de Ph.D. devrait être davantage orienté vers l'industrie (par exemple, par le choix de sujets de recherche plus étroitement associés aux problèmes industriels) et moins vers la science fondamentale. Le fait d'accepter sans mûre réflexion cet argument (2) présente un risque d'erreur.

(1) Committee on Manpower Resources : The Flow into Employment of Scientists, Engineers, and Technologists (Londres 1968) paragraphe 128.

(2) Ou bien un argument connexe, résultant des taux de rendement actuels. Il se pourrait, par exemple au Royaume-Uni que ces taux de rendement de l'enseignement au niveau du doctorat soient faibles du point de vue de l'individu (comme le reflètent les différences de traitement). S'il en est ainsi, ce pourrait être la conséquence d'un malaise industriel temporaire.

Ce manque d'adaptation ne pourrait-il pas résulter principalement d'une inaptitude temporaire de l'industrie à intégrer effectivement ses processus de recherche, de développement et de production ? Dans ces conditions, convient-il de niveler vers le bas le processus d'enseignement ? L'expérience acquise par les entreprises réellement efficaces, dans les industries où les recherches se poursuivent intensément, permet de penser que telle est bien la situation (1). Il est important de reconnaître que l'on peut réglementer indépendamment l'un de l'autre le nombre de titulaires de Ph.D. et la nature du diplôme. Le fait de modifier deux paramètres dans l'état connu d'un système pourrait créer un état totalement inconnu.

Dans d'autres pays, ces problèmes ont pris une forme moins aiguë, ce qui pourrait dans une certaine mesure constituer un argument en faveur d'un système de diplôme non professionnel. Aux Etats-Unis, au Canada et au Royaume-Uni, l'enseignement au niveau du doctorat a sans aucun doute acquis une force vive qui lui est propre et il est peut-être moins sensible aux besoins généraux de la société. L'épreuve critique pourrait être la réaction du système de l'enseignement supérieur à la demande et au financement décroissants concernant l'enseignement au niveau du doctorat, surtout aux Etats-Unis. Cette demande subira-t-elle le contrecoup des besoins décroissants de la société d'aujourd'hui, ou sa dynamique interne l'emportera-t-elle en puissance ?

D. Les études universitaires de 3ème cycle à l'étranger

Parmi les pays de l'OCDE, certains accueillent traditionnellement de très nombreux étudiants étrangers. Dans certains d'entre eux, ceux-ci représentent un pourcentage important du nombre total des étudiants (par exemple, en Suisse 26,3 %, en Autriche 19,4 %) ; dans d'autres, si les pourcentages sont moindres, l'effectif total des étudiants étrangers est en lui-même important (par exemple, Etats-Unis 82.709, France 28.354, Allemagne 22.524) (2). En revanche, certains pays Membres de l'OCDE, notamment la Norvège, la Grèce et la Turquie, envoient traditionnellement de très nombreux étudiants poursuivre leurs études à l'étranger.

Dans l'ensemble - malgré quelques exceptions - cette mobilité de l'enseignement est plus importante (en pourcentage) au niveau des études de 3ème cycle qu'aux niveaux inférieurs. Par exemple, aux Etats-Unis en 1966, le pourcentage d'étrangers dans l'effectif total d'étudiants, qui était de 1,7 %, atteignait 10 % pour les étudiants ayant déjà accédé au premier diplôme universitaire. Un deuxième point important est que si la mobilité des étudiants effectuant leurs quatre premières années d'études décroît à mesure que les systèmes d'enseignement se développent, elle semble augmenter de manière continue au

(1) Une conclusion identique apparaît d'une étude sociologique portant sur les chimistes dans l'industrie britannique "la recherche appliquée dans l'industrie n'offre que des possibilités réduites de déployer réellement ses capacités" S. Cotgrave et S. Box : Science, Industry and Society, chap. V (Londres 1970).

(2) Développement de l'enseignement supérieur 1950-1967. Rapport analytique. Tableau A-3, OCDE (Paris 1971).

niveau des études universitaires de 3ème cycle. Troisièmement, dans les pays qui ont engagé de très importantes dépenses de recherche et de développement, par exemple, au Royaume-Uni et aux Etats-Unis (1) les étudiants étrangers semblent être proportionnellement plus nombreux en sciences pures qu'en sciences humaines ou sociales. S'il n'en est pas ainsi en France, c'est peut-être en raison soit du prestige de la culture française, dans les domaines non scientifiques, soit de l'accroissement relativement plus récent des dépenses consacrées à la science. Ces trois facteurs sont illustrés dans le tableau 11 qui expose la situation au Canada, en France, au Royaume-Uni et aux Etats-Unis. Il est évident qu'un pourcentage très élevé des ressources affectées aux études du 3ème cycle en sciences par certains pays, surtout par le Canada, et par le Royaume-Uni en sciences appliquées, est consacré aux étudiants étrangers. Cette interdépendance a d'évidentes implications sur la possibilité de planifier efficacement la main-d'oeuvre à ce niveau, tant pour les pays qui envoient les étudiants que pour ceux qui les reçoivent.

La structure est assez différente dans les pays comme l'Autriche et la Suisse qui, en partie pour des raisons géographiques et culturelles, accueillent traditionnellement dans leurs établissements d'enseignement de très nombreux étudiants étrangers, mais pas principalement des étudiants en sciences, ni principalement des étudiants au niveau des études de 3ème cycle. Les données figurant dans le tableau ci-après relatives à la Suisse concernent également les étudiants étrangers :

TABEAU 10

Pourcentage des diplômes décernés à des étudiants de nationalité autre que suisse

		1950/51	1960/61	1966/67
Niveau du 1er diplôme	Sciences/technologie	17,0	19,7	22,5
	Toutes disciplines	24,5	27,7	26,5
Doctorats	Sciences/technologie	16,6	20,6	24,9
	Toutes disciplines	13,6	23,6	29,2

Source : Développement de l'enseignement supérieur - 1950-1967. Statistiques par pays. OCDE, (Paris 1970). Les comparaisons sont légèrement confuses en raison du maintien du doctorat en tant que premier diplôme pour les sciences humaines et sociales dans les universités de langue allemande, mais la thèse générale reste valable.

(1) En 1969, parmi les étudiants ayant obtenu le premier diplôme dans les universités des Etats-Unis, le nombre d'étrangers est de 10 %, alors qu'il a atteint 20 % dans les départements de préparation au doctorat ès sciences (17 % en 1967).

La Norvège constitue un exemple d'un pays "exportateur", bien que le pourcentage des étudiants norvégiens qui font leurs études supérieures à l'étranger ait baissé de 30 % de tous les inscrits en 1956/57 à 11 % en 1969/70. Au niveau des études universitaires de 3ème cycle il reste cependant très élevé, et les étudiants sont en fait encouragés à s'inscrire dans des universités étrangères par les programmes de bourses de perfectionnement du Conseil de la recherche scientifique et industrielle. De façon générale ce mode d'éducation pose cependant un problème, car ou bien les étudiants ne reviennent pas, ou bien - s'ils appartiennent à des pays en voie de développement et qu'ils reviennent - ils s'intéressent à des questions sans aucun rapport avec les besoins nationaux, ce qui crée des difficultés supplémentaires.

TABLEAU 11

Effectif d'étudiants étrangers par niveaux
et branches d'études

(pourcentages)

	Tous niveaux	Niveau des études universitaires de 3ème cycle
CANADA	5,5 (1)	48,5 (2)
FRANCE (1966/67) (3)		
Sciences	5,4	10,7
Médecine et pharmacie	8,1	8,5
Droit	5,6	20,4
Sciences humaines et sociales	<u>6,7</u>	<u>30,6</u>
	6,4	13,7
ROYAUME-UNI (4)		
Science pure	2,0	18,1
Science appliquée et sciences médicales	7,1	39,3
Sciences sociales	3,7	31,5
Enseignement	31,0	7,5
Sciences humaines/Lettres	<u>2,8</u>	<u>34,0</u>
	4,2	25,4
ETATS-UNIS		
<u>1950/51</u> <u>1960/61</u> <u>1965/66</u> (6)	<u>1967</u>	<u>1968</u> <u>1969</u> (5)
1,3 1,5 1,7		
Sciences seulement	16,9	18,3 20,0
Ensemble		<u>10</u>

- Notes : (1) 1964/65. Source : Développement de l'enseignement supérieur 1950-1967. Rapport analytique, tableau A-3, OCDE (Paris 1971).
(2) 1967/68 : Sciences seulement. Source : Profile of Graduate Students enrolled for the Doctorate in Science (NRC Ottawa 1968) tableaux 14 et 15.
(3) Source : Annexe B.
(4) Source : Overseas Students in Britain 1967/68 et Statistics of Education (VI, 1967).
(5) 2.338 départements de doctorat ès sciences seulement. Source : Graduate Student Support & Manpower Resources in Graduate Science Education (NSF 70-40).
(6) Développement de l'enseignement supérieur 1950-1967. Rapport analytique, tableau A-3, OCDE (Paris 1971).

Pour un grand nombre de pays Membres de l'OCDE, il n'y pas de doute que ces considérations doivent être l'élément important de toute politique relative aux études universitaires de 3ème cycle. En particulier, l'ampleur de cette mobilité des étudiants, particulièrement en sciences pures, rend à la fois difficile et incertaine la planification de l'extension des études universitaires de 3ème cycle, et la comparaison entre la production de l'université et les prévisions de besoins nationaux en main-d'oeuvre. Bien entendu, cette conclusion ne réduit en rien les avantages importants - par exemple, en matière de compréhension internationale - que l'on retire des échanges didactiques et scientifiques.

E. La planification des études universitaires de 3ème cycle

Parmi les pays examinés en détail aux fins de la présente étude, le Royaume-Uni est le seul qui se soit délibérément efforcé, par principe, de réglementer la "production" de titulaires de diplômes supérieurs. En particulier, les autorités britanniques pensent implicitement, depuis longtemps, que le nombre de docteurs (Ph.D.) "produits" est supérieur à celui que l'économie peut profitablement absorber. Au contraire, comme nous l'avons montré, les plans de la France font ressortir des besoins croissants en matière de chercheurs, et il en est de même en Allemagne en ce qui concerne les professeurs d'université. Il s'ensuit que dans ces deux pays, le développement de la formation des chercheurs doit manifestement être encouragé. En Allemagne, bien que le doctorat ne soit pas considéré comme donnant une formation professionnelle en matière de recherche, on admet de plus en plus qu'il constitue en quelque sorte un élément de la préparation à une carrière universitaire. Cependant, seul un mouvement fortement orienté vers l'élimination de la barrière traditionnelle à la profession universitaire - l'Habilitation -, permettra d'affermir cette tendance. En Norvège, la situation est différente parce que le Cand. Real., bien qu'il implique un élément important de recherche, est loin d'être un diplôme professionnel. Alors qu'il constituait à l'origine, une préparation à l'enseignement dans une école secondaire, il est maintenant accepté comme une forme d'enseignement approprié pour tous les étudiants qui souhaitent le suivre. Il est donc impossible d'établir des plans normatifs concernant spécifiquement la "production" de titulaires du Cand. Real. ; de même, aux Etats-Unis, pour des raisons très différentes, aucune tentative n'a été faite jusqu'ici pour réglementer la production de titulaires du Ph.D. La capacité d'absorption de "docteurs" par l'économie, stimulée par les besoins fédéraux en matière de chercheurs, a été importante. Cependant, il est probablement exact que, dans de nombreux pays, les responsables de la politique scientifique s'attachent de plus en plus (pour des raisons qui peuvent cependant différer selon les pays) à réglementer l'offre de certaines catégories de main-d'oeuvre. Les chercheurs pourraient être l'une de ces catégories, et ceux qui préparent le Ph.D. ou un diplôme de niveau équivalent pourraient constituer une très importante sous-catégorie.

Un tel exercice suscite d'importantes difficultés, de nature aussi bien conceptuelle que pratique. Les premières peuvent se résumer comme il suit :

- (i) l'offre est difficile à évaluer tant en raison de sa médiocre corrélation avec la "production" du système d'enseignement que de l'incertitude qui plane sur les carrières choisies par les étudiants ;

- (ii) l'offre et la demande ne sont pas des variables indépendantes, elles réagissent l'une sur l'autre par l'intermédiaire du marché du travail ;
- (iii) il est dangereux de tenter de réglementer le nombre de places, en fonction de l'évaluation de la situation actuelle, si précise que soit cette évaluation ;
- (iv) on ne sait pas bien s'il faut lier à l'offre le besoin ou bien la demande. La plupart des prévisions nationales ont utilisé le premier de ces critères, mais ce concept reste vague ;
- (v) des objections d'ordre idéologique s'opposent à l'élaboration des dispositions concernant l'enseignement en fonction des plans de main-d'oeuvre, car de nombreux pays estiment que la demande sociale est l'élément déterminant essentiel.

En outre, il faut faire face à des obstacles d'ordre pratique. Le premier résulte de l'existence de multiples centres d'influence, en matière de financement de la préparation à la recherche, même lorsque celle-ci est concentrée dans les universités. Les fonds et (en conséquence) les plans émanent tous deux à la fois des organismes chargés de l'enseignement et des organismes de recherche. Les branches d'études dans lesquelles les subventions pour la recherche sont rares et réduites (par exemple les sciences humaines et sociales, les langues et les beaux-arts), n'ont guère à affronter ce problème ; mais en sciences pures, ces deux types d'organismes sont des centres d'influence rivaux. L'importance de cette répartition des responsabilités doit être reconnue, avant tout examen de l'organisation de l'enseignement de la recherche en sciences. Dans les pays où l'organisation est centralisée, le mécanisme de coordination interministérielle peut être assez aisément établi, tout au moins en principe. Cependant, rien ne garantit que les objectifs puissent être conciliés. L'engagement pris d'ouvrir le plus largement possible aux jeunes d'un pays l'accès à tous les niveaux d'enseignement qu'ils désirent atteindre (ce qui répond à la vocation d'un ministère de l'éducation) et la volonté d'équilibrer l'offre et la demande relatives à la main-d'oeuvre de recherche peuvent être fondamentalement opposés. Les problèmes de planification auxquels doivent faire face les pays à organisation fédérale sont beaucoup plus sérieux. Dans presque tous les pays Membres qui répondent à cette définition, l'enseignement supérieur est la prérogative jalousement défendue des états, des cantons, des provinces ou des Länder. Dans tous les pays où il en est ainsi, par exemple aux Etats-Unis, en Suisse, au Canada et en République fédérale d'Allemagne les universités sont en grande majorité traditionnellement financées par les régions où elles sont implantées. Un financement supplémentaire émanant des autorités fédérales est considéré comme une ingérence dans l'autonomie locale, qui peut être plus ou moins gravement ressentie. De nombreux pays de ce type n'ont pas de ministère de l'éducation à l'échelon fédéral. L'octroi aux universités, par le gouvernement fédéral, de fonds plus ou moins importants exclusivement consacrés à l'enseignement tend à être une question de politique intérieure. Au contraire, bien entendu, la recherche scientifique est devenue partout une responsabilité majeure du gouvernement central. Dans tous les pays, les universités en sont venues à compter

sur le gouvernement central pour obtenir des subventions de recherche pour des projets spécifiques ("opportuns et féconds"), en complément des fonds affectés à la recherche sur les budgets généraux des universités. Presque tous les pays de l'OCDE ont créé un organisme central - un Conseil de la recherche - qui attribue de tels fonds aux chercheurs des universités. Les universités deviennent de plus en plus tributaires de ces fonds, et cette situation a sur elles un profond retentissement (1).

La création d'un mécanisme efficace de coordination entre un organisme de recherche central et des organismes d'enseignement d'Etat autonomes est manifestement difficile. Le Wissenschaftsrat (Conseil de la Science) est un organisme ouest-allemand créé à cette fin, qui est composé de représentants des ministères de l'éducation des Länder, du gouvernement fédéral et des milieux scientifiques. Un tel organisme ne peut avoir qu'un caractère consultatif et le statut incontestablement élevé du Wissenschaftsrat et son influence dépendent de la qualité de ses analyses plutôt que de ses pouvoirs exécutifs. En raison des différences qui existent entre leur situation financière, leur climat politique, et leur population, les états ont fréquemment des objectifs différents en matière d'enseignement supérieur, et il peut être pratiquement impossible de concilier toutes ces positions avec une position centrale alors qu'une telle harmonisation est indispensable pour planifier l'enseignement de la recherche. Le Wissenschaftsrat lui-même considère que son rapport de 1966 sur la réorganisation des études universitaires, par exemple, n'a guère été suivi d'application.

Dans quelle mesure peut-on établir des plans efficaces ? La planification de l'enseignement est toujours difficile : les responsables gouvernementaux ne peuvent jamais réglementer tous les facteurs qui influencent le système d'enseignement. Il en est ainsi au niveau des études universitaires de 3ème cycle comme à d'autres niveaux du système d'enseignement, en raison de la multiplicité des sources de financement. Nous avons déjà montré combien la planification est difficile à l'échelon gouvernemental, parce que les fonds consacrés aux traitements des étudiants proviennent à la fois d'organismes chargés de l'enseignement et de la recherche. Cependant une coordination est possible. En fait, dans la majorité des grands pays Membres, de très nombreux étudiants spécialisés dans la recherche reçoivent des subventions qui échappent au contrôle des planificateurs gouvernementaux. Au Royaume-Uni, par exemple, environ 35 % des étudiants britanniques préparant le Ph.D. en sciences et en technologie reçoivent une aide financière de sources non gouvernementales ; aux Etats-Unis, plus de 60 % de ces étudiants ayant obtenu leur premier diplôme reçoivent des subventions émanant de sources non fédérales, l'industrie est l'une de ces sources : au Royaume-Uni, plus de 1.300 étudiants préparant un Ph.D. en sciences et en technologie ont été rémunérés sur des fonds industriels en 1969 (2). De nombreux responsables de la politique scientifique

(1) Voir Orlans H.: The effects of Federal Programs on Higher Education (Washington: Brooking Institution 1965).

Blume, S.S.: "Research Support in British Universities - the Shifting Balance of Multiple and Unitary Sources" Minerva VII(4) (1969).

(2) Ce chiffre représente plus de 11 % du total, mais dissimule de larges variations entre les diverses disciplines ; ainsi, le pourcentage était de 17,4 % en chimie et de 4,8 % seulement en biologie.

s'attachent à encourager l'industrie à subventionner la recherche universitaire, mais on se rend rarement compte que plus ces subventions sont nombreuses, plus il devient difficile de limiter la "production" de Ph.D. Le financement de la recherche par des sources multiples présente à la fois des avantages et des inconvénients. On peut penser que plus la recherche universitaire sera développée plus ses liens avec l'industrie seront étroits et, plus il sera impossible de planifier l'enseignement de la recherche. Le même argument peut s'appliquer au soutien gouvernemental apporté à la recherche universitaire : il est possible qu'un soutien émanant d'utilisateurs très divers offre moins de possibilités de coordination ou de contrôle que s'il était accordé par un organisme unique. Si cette forme d'enseignement ne constitue pas une dépense directe des fonds publics, pourrait-on avancer, il est inutile que les gouvernements s'en préoccupent. Cependant, le problème n'est toujours pas résolu, si l'on admet que les possibilités de réaffectation de la main-d'oeuvre varient en raison inverse de l'âge et de la spécialisation. En d'autres termes, les titulaires de Ph.D. sont moins susceptibles d'accepter n'importe quel emploi offert sur le marché que des candidats ayant des qualifications moindres.

Le problème est moins aigu dans les disciplines non scientifiques. Les dépenses en capital qui doivent être consenties pour inciter un plus grand nombre d'étudiants à poursuivre des études de 3ème cycle sont moindres que dans les disciplines scientifiques, et il n'existe pas de centres d'influence rivaux. En outre, l'expansion a été moins rapide et l'interaction avec l'économie moins directe. Cependant, il existe visiblement une interaction avec le système d'enseignement, et le développement de l'une ou l'autre catégorie d'études de 3ème cycle peut être nécessaire pour pallier une pénurie de professeurs de l'enseignement secondaire ou supérieur. Cette situation peut se présenter aussi bien en philosophie ou dans l'étude des langues, qu'en chimie. En conséquence, non seulement le problème est moins aigu dans ce cas qu'en sciences, mais l'enseignement secondaire offre aux diplômés des disciplines non scientifiques des possibilités de carrière beaucoup plus acceptables et plus nombreuses qu'aux titulaires de Ph.D. ès sciences.

F. Quelques considérations finales

Dans les sections précédentes, nous nous sommes efforcés de traiter les questions dont doit tenir compte toute politique concernant l'enseignement de 3ème cycle. Bien qu'elles soient examinées en fonction surtout des problèmes qui se posent dans les sciences pures, ces questions ne sont pas propres à ces disciplines : ce sont plutôt les pressions qui s'exercent en vue de la formulation d'une politique spécifique en matière d'études de 3ème cycle qui sont les plus fortes. En second lieu, nous avons étudié plus particulièrement les problèmes des pays dans lesquels le doctorat est "professionnalisé" (voir section II) plutôt que ceux des pays où il ne l'est pas. Dans ces derniers, on constate une tendance marquée vers l'introduction d'un diplôme à orientation professionnelle analogue au Ph.D. Ces diverses questions ont donc un certain intérêt d'ordre général.

Les problèmes majeurs relatifs aux études de 3ème cycle se posent surtout dans les pays dans lesquels l'équilibre entre l'enseignement traditionnel et un système scientifique moderne est encore instable. Fréquemment, l'expression études universitaires

de 3ème cycle couvre des activités qui reviennent à "verser du vieux vin dans des bouteilles neuves" : l'étiquette est trompeuse. Il en est particulièrement ainsi lorsqu'un cours conduisant à un diplôme qui exige traditionnellement une longue préparation est réparti en deux étapes - dont la deuxième devient le "3ème cycle d'études". Le manque de prestige du grade intermédiaire nouvellement créé pose inévitablement un problème. Ni le M.A. en Allemagne, ni le Cand. mag. en Norvège, ni la licence en Suisse allemande n'ont encore pu se dépouiller de leur image de "poste de relais". Cette question est manifestement importante pour les pays qui recourent à cette méthode de scission des cours pour créer un cycle d'études de 3ème cycle. Le problème du statut se pose en France sous un jour différent, bien qu'il dérive ici encore de la juxtaposition du neuf et du vieux, par exemple la priorité accordée aux agrégés par rapport aux titulaires du doctorat de spécialité pour l'accès aux postes universitaires dans les facultés de droit et de lettres est significative à cet égard. Si les doctorats ès lettres et ès sciences offrent de l'intérêt c'est uniquement pour la carrière universitaire, car une préparation aux méthodes de recherche dans ces disciplines est, sans aucun doute possible, un aspect essentiel de la formation des futurs professeurs. Ici encore, le neuf et le vieux coexistent au détriment du premier.

Certains cycles d'études universitaires de 3ème cycle, créés par adjonction au système traditionnel, plutôt que par division, (comme, par exemple, aux Etats-Unis et au Royaume-Uni, les cycles de Bachelor's Degree, de Master's Degree et de Doctorate) ne semblent guère souffrir d'un tel manque de prestige, mais il ne serait pas exact de dire que ce système est entièrement exempt de difficultés de cet ordre. Aux Etats-Unis en particulier, le statut limité du Master's Degree pose un grave problème, qui procède, dans une large mesure, d'une part de la facilité d'admission aux études préparatoires au doctorat, et d'autre part de l'emploi du diplôme à la fois comme un relais automatique sur la voie du doctorat, et comme une compensation pour ceux qui échouent aux épreuves du doctorat. Il ne saurait y avoir de doute que les effets de cet usage abusif sont regrettables. Le maintien d'un premier diplôme universitaire "non professionnel" et assez général exige qu'un diplôme professionnel du type Master's Degree sanctionnant une à deux années d'études soit offert. De plus en plus, celui-ci devra peut-être devenir une véritable alternative au doctorat, orientée vers l'emploi, et non pas une étape de l'accession à ce titre. A une époque où les besoins de la société en personnel de recherche décroissent, une partie de la demande des étudiants, en matière d'enseignement de 3ème cycle, peut très profitablement être orientée vers des cours de Master's Degree. La valeur de telles études "professionnelles" de 3ème cycle d'une durée d'un à deux ans, est de plus en plus largement reconnue. Au Royaume-Uni, par exemple, la politique suivie vise de plus en plus à canaliser les étudiants vers un tel enseignement. L'introduction en France du diplôme d'études avancées (et de l'attestation d'études avancées) parmi les conditions requises pour accéder au doctorat spécialisé (orienté vers la recherche et l'enseignement) est un pas dans la direction que nous préconisons. L'orientation professionnelle du diplôme d'études avancées constituerait un deuxième pas sur cette voie. En d'autres termes, on pourrait offrir un diplôme d'études avancées qui constituerait à la fois une qualification professionnelle orientée vers l'emploi, et une épreuve d'aptitude à la recherche.

De nombreux pays de l'OCDE n'ont pas créé de diplômes de recherche à orientation professionnelle analogues au Ph.D., bien que leurs universités délivrent des diplômes qui impliquent une importante composante de recherche. Des scientifiques réclament de plus en plus fortement qu'un tel diplôme soit institué. A cette fin, on estime en général qu'il faudrait conférer un caractère magistral à la composante de recherche de ce diplôme, c'est-à-dire y introduire des directives systématiques appropriées à l'intention des étudiants poursuivant des recherches. En Allemagne, le Wissenschaftsrat réclame depuis longtemps que de telles mesures soient mises en oeuvre ; un enseignement magistral paraît être un élément nécessaire d'un diplôme orienté vers la formation des chercheurs, qui semble répondre à un besoin croissant, dans tous les pays. Toutefois, une remarque s'impose. D'après l'expérience acquise en Amérique du Nord et au Royaume-Uni, un tel système de diplômes pourrait aisément devenir autonome. Or la "production" directe de chercheurs par le système d'enseignement doit être contrôlée, en fonction de considérations de politique scientifique ; il est donc indispensable que des contrôles s'exercent sur l'ampleur de cette production. Ces contrôles doivent être liés à une certaine évaluation des besoins en chercheurs et en professeurs d'université. Cependant il convient peut-être aussi que les pays, dans lesquels le diplôme professionnel de recherche existe, ne perdent pas de vue qu'ils ont l'obligation d'instruire les étudiants en même temps qu'ils les forment à une profession.

Cependant, une fois encore, nous suggérons qu'un enseignement de la recherche de cette nature n'est qu'un type - et une possibilité - parmi d'autres d'études universitaires de 3ème cycle. A mesure que le concept tout entier de la politique scientifique évolue, comme il le fait actuellement, il semble que d'autres possibilités prendront une importance nationale croissante.

ANNEX A

POSTGRADUATE EDUCATION IN CANADA

TABLE OF CONTENTS

	<u>Page</u>
I. <u>GROWTH OF GRADUATE STUDIES</u>	103
II. <u>SUPPORT OF POSTGRADUATE STUDENTS</u>	103
(a) The Role of the National Research Council.....	105
(b) Support for Science Students from Other Sources.....	109
III. <u>BALANCE BETWEEN RESEARCH AND COURSE-WORK BY FIELD</u>	110
IV. <u>THE NATURE OF THE PH.D.</u>	113
(a) History and Growth	113
(b) Transition Ratios (no information).....	113
(c) Content, Duration, and Success or Failure.....	113
(d) Contribution to Sectoral Research Effort	114
(e) Unorthodox Ph.D. Schemes	115
V. <u>OTHER POSTGRADUATE WORK</u>	116
VI. <u>SUBSEQUENT EMPLOYMENT</u>	116
VII. <u>POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM</u>	120
SOURCES OF TABLES	124
BIBLIOGRAPHY	125

I. GROWTH OF GRADUATE STUDIES (1)

The Ph.D. in Canada dates from the first decade of this century. In 1911 there were 47 students registered, and these were restricted to two universities, Toronto and McGill. There was little research in Canadian universities at that time and students who wished to go on to do research were encouraged to go either to the United States or to the United Kingdom. Gradually, master's degree programmes were introduced, first in basic and then in applied science, but doctoral work grew very slowly. As late as 1934 (when still only Toronto and McGill offered doctorates) a prominent academic argued that the demand for graduates trained to the doctoral level was too small to justify a large graduate effort. By 1940, 5 universities had Ph.D. programmes, but in the late forties and early fifties a rapid upgrading of existing institutions took place. However, many institutions even now permit only the stronger departments to offer Ph.D.s, and departments have to apply in writing to some central administrative body of the university for permission. Thus, of the 62 institutions which offer higher education diplomas, 25 have developed doctoral programmes and about another 8 have a very few research students.

The postgraduate student population has thus increased fairly rapidly, but more rapidly in recent years in non-science subjects. Graduate students in science and engineering, who represented 47.7 per cent of the total graduate student population in 1963-64, were only 43.1 per cent in 1966-67 - a proportion which was estimated as declining to 40.2 per cent by 1970-71.

II. SUPPORT OF POSTGRADUATE STUDENTS

There is no regular collection of data on student support in Canada and it is necessary to rely on ad hoc sample surveys. Fortunately, there have been a number of these surveys. We have made use of surveys by Thompson and by Stock and Beaulieu relating to 1958-59 to 1959-60, which we have combined together, and also by Macdonald *et al.* relating to 1967-68. Data from the former are summarised in Table II, and from the latter in Table III.

TABLE I

A. POSTGRADUATE STUDENTS AS PERCENTAGE OF ALL ENROLLED STUDENTS

<u>1920-1</u>	<u>1930-1</u>	<u>1940-1</u>	<u>1950-1</u>	<u>1959-60</u>
1.8	4.1	4.3	6.6	5.2
<u>1963-4</u>	<u>1964-5</u>	<u>1965-6</u>	<u>1966-7</u>	<u>1967-8</u>
7.0	7.8	8.4	9.0	19.37

B. POSTGRADUATE SCIENCE AND ENGINEERING STUDENTS AS PERCENTAGE OF ALL ENROLLED STUDENTS

<u>1963-4</u>	<u>1964-5</u>	<u>1965-6</u>	<u>1966-7</u>	<u>1967-8</u>
3.3	3.6	3.8	3.9	14.07

(1) This section is largely taken from W.P. Thompson: Graduate Education in the Sciences in Canadian Universities (Toronto U.P. 1963).

TABLE II
APPROXIMATE DISTRIBUTION OF SUPPORT FOR SCIENCE
AND ENGINEERING STUDENTS 1965-60

Total Number of Students	3,271
Scholarship Support { N.R.C.	423
{ University	230
{ Other	170
Assistantships { Teaching	420
{ N.R.C. research	714
{ Other research	700
Other	200
None	250

TABLE III
EXPENDITURE ON POSTGRADUATE STUDENT SUPPORT (ALL DISCIPLINES)
1967-68

<u>SOURCE</u>	<u>AMOUNT (\$000)</u>
<u>Federal Agencies</u>	
(a) <u>Scholarships</u>	
N.R.C.	5,480
M.R.C.	1,779
Canada Council	6,477
C.M.H.C.	258
Labour	12
External affairs	568
External aid	808
Other	171
(b) <u>Research Grants</u>	
N.R.C.	4,912
M.R.C.	934
Federal Agencies - all	21,399
Provincial governments - direct support	7,150
University scholarships through general revenue	1,685
University-administered endowments	1,704
Teaching assistantships	10,610
TOTAL	42,548

Notes

N.R.C.: National Research Council
M.R.C.: Medical Research Council
C.M.H.C.: Central Mortgage and Housing Corporation

It is difficult to know how many of the 25,000 graduate students enrolled in 1967-68 received this money. According to a study by J.B. Hyne (quoted by Macdonald et al., p. 201), 16 per cent of students received no money from official sources. This would suggest an average support figure of \$2,000 for 21,000 students. However, support differs greatly from discipline to discipline being on average higher in the sciences: for instance, the N.R.C. scholarship is worth \$3,600. It is the distribution of responsibility between the agencies which is of most importance for our present purposes, and this is brought out by expressing the data of Table III in approximate percentage terms:

Federal Agencies	50%
[research grants 13%; scholarships 37%; N.R.C. 25%]	
Provincial Governments	15%
Teaching Assistantships	25%
Other	10%

[The teaching assistantships may be proportionately more important in non-science disciplines.] The National Research Council, which spends 25 per cent of all student support funds, is thus the single major source of support. It is therefore the agency which is most likely to be able to exercise some control over postgraduate education in science and technology. Its role needs to be examined in greater detail.

(a) The Role of the National Research Council

(i) Scholarship and bursary system

Discounting postdoctoral fellowships, which are not strictly relevant here, it can be seen that the N.R.C. supports research students by four scholarship-type mechanisms.

- (\$3,600 p.a.) - Postgraduate scholarships for the first year of postgraduate study (not renewable)
- (\$3,600 p.a.) - Postgraduate scholarships for subsequent years of postgraduate study - awarded to students with postgraduate experience (renewable)
- (\$3,000) - Bursaries (not renewable but new application may be made)
- (\$5,000) - 1967 science scholarships (highly competitive, high value scholarships - up to 50 new awards annually. Must be held at a university other than that of bachelor graduation).

In 1968-69 the numbers awarded, and applications received, were:

	<u>Applications</u>	<u>Awards</u>
Scholarships	3,230	2,238
Bursaries	392	392
1967 Scholarships	109	90

Bursaries are allocated to universities on a quota basis. The scheme was introduced in 1968. Universities are responsible for the selection of students. The quotas appear to be based upon size of university (or, more accurately, its graduate enrolment in science) and there is a precise correlation between the number held at each institution and its graduate enrolment.

They are not therefore intended as an aid to research so much as an aid to the students, and they are not, although they could be, used to encourage a concentration of research effort. The distribution between fields and institutions of the bursaries held in 1968-69 was as follows:

TABLE IV
DISTRIBUTION OF N.R.C. BURSARIES BY FIELD (1968-69)

	<u>No. Held in Each Discipline</u>	<u>No. of Institutions Giving Awards in Each Discipline</u>
Mathematics	45	14
Physics	52	19
Chemistry	68	28
Engineering Technology	104	19
Biological sciences	58	17
Earth sciences Agriculture	26	12
Psychology	26	14
Total	391	34

Clearly, more graduate schools are involved with chemistry research than is the case with other scientific disciplines. Engineering/technology is, between its various parts, the subject which receives the highest allocation of these awards, but in a fairly restricted number of institutions. (The universities of Toronto and Waterloo receive 38 of the 104 engineering bursaries.)

Scholarships are awarded to students, who are therefore in competition with one another. Only students who have been accepted by a graduate school for advanced study or research leading to a higher degree are eligible. Awards may be granted for study in agriculture, biology, chemistry, physics, geology, physical geography, mathematics, engineering and experimental psychology. Awards may be held abroad if facilities for the projected course of study are not available in Canada. In addition, it appears that these awards are used to support the most able students primarily, and it is to be doubted that allocations are made to individual fields on the basis of national need. [If many students are supported from research grants, as is the case in Canada, then priorities in the allocation of these grants will be reflected to some extent in student distribution.]⁷

In 1968-69, 1,888 scholarships were taken up. The distribution between fields is shown below. The table also shows the percentage of students in each discipline supported in this way.

TABLE V
DISTRIBUTION OF N.R.C. SCHOLARSHIPS BY FIELD AND PROPORTION
OF STUDENTS SUPPORTED IN EACH FIELD (1968-69)

	<u>No. Scholarships Awarded</u>	<u>%</u>	<u>% of Students in Field (1)</u>
Mathematics	290	13	27
Physics	338	15	29
Chemistry	377	17	24
Biomedical sciences	324	15	9
Agricultural sciences	56	3	22
Earth sciences	101	5	10
Engineering/Technology	565	26	15
Psychology	119	5	} 8
Others/undecided	28	1	
Total	2,198	100	16

(1) This figure is an approximation. The number of scholarships given in column 1 is the number awarded; it includes some which were subsequently declined, and others which were held abroad. The low figure for biomedical sciences must be seen in the light of the division of responsibility for this field with the M.R.C.

(ii) Support from research grants

Almost as many postgraduate students are supported from research grants awarded for specific projects to senior investigators as are supported from the studentship programme. The Report of the Forecasting Committee of the N.R.C. suggests that the opportunity for postgraduate students to receive support from research grants has increased more rapidly than has the possibility of obtaining a scholarship directly. However, comparable series of data do not seem to be available. In 1967-68, the distribution of student support from research grants, by field and size of grant, was as follows:

TABLE VI
DISTRIBUTION OF SUPPORT FROM N.R.C. GRANTS (1967-68)

	<u>up to \$500</u>	<u>\$501-\$1,500</u>	<u>over \$1,500</u>	<u>Total</u>	<u>%</u>
Physical sciences	43	224	205	472	51
Engineering	4	29	160	193	21
Life sciences	22	37	105	164	18
Psychology	6	38	20	64	7
All other	4	5	24	33	3
Total	79	333	514	926	100

In the same year, 1,044 students held scholarships. Thus, the grant mechanism supported 47 per cent of all N.R.C.-supported students.

(iii) Overview of the role of the N.R.C.

The distribution of N.R.C. support for students by discipline follows very closely the distribution of overall enrolments, indicating, as Levine suggests (1), that N.R.C. seeks to respond to the preferences of students for graduate work.

TABLE VII

OVERALL COMPARISON OF N.R.C. SUPPORT WITH ENROLMENTS (1967-68)

Discipline	Enrolment	% Distribution of Number of Students		
		Support from N.R.C. Funds		
		Studentships	Grants	Total
Physical sciences	51	53	51	52
Engineering	18	20	21	21
Life sciences	18	17	18	17
Psychology	11	6	7	6
Other	2	4	3	4
Total	100	100	100	100

In 1967-68, the 1,044 studentship holders and the 926 students assisted from N.R.C. research grants together amounted to 42 per cent of all students enrolled for the doctorate. However, relatively few students are supported solely from N.R.C. funds, as shown by Table VIII below.

TABLE VIII

MULTIPLICITY OF STUDENT SUPPORT SOURCES

Discipline	Total No. of Students	Supported solely by N.R.C. funds	Supported solely by non-N.R.C. funds	Mixed N.R.C. and non-N.R.C. funds
Physical sciences	2,343	152	1,311	880
Engineering	839	211	437	191
Life sciences	842	158	505	179
Psychology	533	37	411	85
All other	82	20	5	57
Total	4,639	578	2,669	1,392

Since N.R.C. support for many students (about 1/4 of all those assisted) comes from a grant to their supervisor of less than \$1,500, the necessity for further finance is obvious. Thus, only 12.5 per cent of students are supported entirely by the N.R.C.

(1) O.H. Levine: "Profiles and Characteristics of Graduate Students Enrolled for the Doctorate in Science and Engineering at Canadian Universities" (1968, Economic Study E.S.4).

Clearly, its capacity to influence graduate enrolments as between different disciplines by such financial incentives is severely limited both by this low percentage and by the mechanisms of support employed. Research grant applications cannot be judged so easily both in terms of their value as potential pieces of research and in terms of their contribution to graduate education policy. However, although such a means of support may not offer the same possibilities of central control, it could have another property which merits discussion. Would support of students from research grants enhance even more than is usual the use of predoctoral students as research assistants, reducing, as a consequence, the educational value of their work. This is a property of the system which may be worthy of consideration. Indeed, the current (1968-69) report of the N.R.C. on the support of university research indicates (p. 14) that arguments have been made for restricting the support of students from research grants. Furthermore, research proposals are apparently judged primarily in terms of the merit of the researcher, not his proposal, as has been shown in previous publications (1). This further complicates the issue and makes comparisons with other countries more difficult.

(b) Support for Science Students from Other Sources

There is not very much information on the support of research students from non-N.R.C. sources. An attempt has already been made to summarise the studies of Thompson and of Stock and Beaulieu, but these studies are now ten years old. We must henceforth rely on estimates. In the first place, assuming that research grants and contracts other than those from the N.R.C. are used for similar purposes and in similar ways to those from the N.R.C., then the extent of postgraduate support from non-N.R.C. research grants can be estimated.

TABLE IX
ESTIMATION OF STUDENT SUPPORT FROM VARIOUS RESEARCH GRANTS
IN SCIENCE AND ENGINEERING (\$ m)

Sources	Actual Operating Funds 1964-65	Estimation of Operating Funds 1967-68	Estimated Number of Students Supported from Funds 1967-68
National Research Council	9.2	24.5	926
Other Federal sources	3.9		
Provincial governments	2.0		
Business and industry	1.2		
United States Government	1.9		
All other non-university sources	1.5		
<u>Sub-total</u>	10.5	18.8	710
University funds	19.8	38.1	<u>2007</u>
TOTAL	39.5	81.4	

Sources: 1964-65
Excludes medicine.

(1) Reviews of National Science Policy: Canada. OECD, Paris, 1969, p. 216.

It is not likely that research funds drawn from internal sources would be used in the provision of research assistantships to the same extent as are external funds, since these funds cover staff salaries, administrative overheads, etc. Although the estimate has little justification, it has been assumed here that 200 research assistants are paid from these funds. Thus, 1,800 postgraduate students in science and engineering were financed from research grants in 1967-68, or 39 per cent of the total.

It has already been indicated that other major sources of support are teaching assistantships, and scholarships. We have no information on these which distinguishes science from non-scientific disciplines.

In conclusion, it must be admitted that it is very difficult to describe the Canadian system for the support of postgraduate students, and we can but quote Levine:

"To speak of a system is really misleading because the implications are that there are Government and non-Government programmes which, although functioning independently of each other are, on an overall basis, linked together into a co-ordinated unit. In fact, both Government and non-Government programmes of support of the graduate student are characterised by multiple, inadequately co-ordinated sub-systems."

Although this may mean that any sufficiently determined student has a good chance of obtaining assistance somewhere, it has three particularly adverse effects:

1. Student support is a major means of control of doctorate output, and the implied lack of centralisation - and hence the possibility of control - could be of real concern at a time when graduate output might be outrunning the absorptive capacity of the economy (see section VII).
2. The very common employment of doctoral students as research and teaching assistants frequently allows them less time for their degree work than is desirable. Hence doctorates are seriously protracted (see section IV).
3. Because recipients of doctorates are very mobile on moving into employment (see section VI) provincial authorities may not be anxious to maintain their share of the ever-increasing doctoral education budget. Although the erosion of provincial autonomy in education at this level may be a far less political issue than at other levels, and may indeed be welcomed, there remains a problem in the planning of provision for higher education. If funding is entirely separated - so that provinces pay for the bulk of first and second cycle education and the federal authorities for the bulk of third cycle - the co-ordination of planning may be difficult.

III. BALANCE BETWEEN RESEARCH AND COURSE-WORK BY FIELD

Table X below shows, on the one hand, current 1968-69 enrolments for research (i.e. doctorates), and, on the other, advanced training (master's degrees) in various scientific disciplines.

TABLE X
BALANCE BETWEEN RESEARCH AND ADVANCED COURSE-WORK
BY SCIENTIFIC DISCIPLINE (1968-69) (1)

	Enrolment at Doctoral Level	Enrolment at Master's Level	Total
Mathematics	429	655	1,084
Physics	494	662	1,156
Chemistry	910	682	1,592
Life sciences	1,490	1,759	3,249
Earth sciences	410	589	999
Engineering/Technology	1,065	2,646	3,711
Agricultural sciences	63	186	249
Medical sciences	117	226	343
Other	678	1,071	1,749
TOTAL	5,656	8,476	14,132

(1) "Life sciences" include biochemistry, biophysics.

"Other" includes principally psychology (experimental and non-experimental), archaeology, geography.

The ratios of master's enrolments to doctoral enrolments are, as might be expected, high in the applied sciences. They are also appreciably greater than 1.0 for pure sciences, with the sole exception of chemistry. Only in chemistry are more than 50 per cent of graduate students working for doctorates, although chemistry doctoral students do not represent the high percentage of all doctoral students that they do in the United Kingdom, for example. [Interestingly, the equivalent figures for physics for 1966-67 were: doctoral enrolments 462 and master's 441; in this case, therefore, doctorate level growth has been kept down relative to master's degree level.]

Table XI gives equivalent data for the social sciences and humanities with reference to 1966-67 - the latest date for which such data were available.

TABLE XI

BALANCE BETWEEN RESEARCH AND ADVANCED COURSE-WORK
IN HUMANITIES AND SOCIAL SCIENCES

1966-67

Field of Studies	Total	Doctorate	Master's
Commerce	1,680	13	1,667
English	1,287	300	987
Education	1,075	207	868
Psychology	1,019	503	516
History	930	260	670
Modern languages	869	290	579
Philosophy	644	327	317
Literature	637	137	500
Economics	569	149	420
Social science	549	38	511
Political science	536	185	351
Sociology	461	100	361
Geography	442	92	350
Religion	263	53	210
Classics	153	44	109
Anthropology	126	47	79
Music	90	16	74
Planning	82	-	82
Romance studies	77	11	66
Slavic studies	77	19	58
Medieval studies	76	51	25
Linguistics	69	29	40
Public administration	47	-	47
International affairs	27	-	27
Canadian studies	26	-	26
Fine arts	24	7	17
Drama	23	8	15
Archaeology	22	13	9
Near Eastern studies	19	7	12
Asian studies	16	-	16
Industrial relations	11	-	11
Accounting	8	-	8
Islamic studies	4	2	2
Total	11,038	2,908	8,130

IV. THE NATURE OF THE Ph.D.

(a) History and Growth

It has already been indicated in section I that graduate education in Canada, especially at the doctoral level, was relatively restricted prior to the 1940s. Nevertheless, in science and technology it had received a stimulus in 1917 with the foundation of the National Research Council, which soon made the production of more people trained in research a major objective and to that end instituted its grant and scholarship system. The development of the Ph.D. system is shown in Table XII.

TABLE XII
NUMBER OF Ph.D.s AWARDED IN CANADA (ALL SUBJECTS)

1910-11	0
1920-21	24
1930-31	46
1940-41	75
1950-51	202
1960-61	305
1961-62	321
1962-63	421
1963-64	481
1964-65	569
1965-66	703
1966-67	787

A recent N.R.C. study suggests that the capacity for Ph.D. production is somewhat under-utilised. If output is considered in more detail, it appears that recent growth has been compounded of a consistent rate of growth on the part of five or six large universities, and an inconsistent zig-zag on the part of the others.

(b) Transition Ratios by Discipline

There are no data available which show the percentage of graduates in each discipline going on to take postgraduate education.

(c) Content, Duration, and Success or Failure

Clearly, the content of a Ph.D. course is likely to be, or should be, determined by the prior level of attainment of students entering it. It is useful, therefore, to look briefly at this factor.

Traditionally in Canada doctoral study has been restricted to holders of the master's degree, and, in 1967-68, 74 per cent of all those registered in science and engineering did indeed hold this degree. However, direct entry from the baccalaureate is now increasingly common. Although 26 per cent of registered doctoral students held only the bachelor's degree, the figure covers variations by field: 32.5 per cent of students in the physical sciences, 16.7 per cent of students in engineering. In practice, whilst some universities continue to require the master's degree, others do not.

Even though students are likely - though decreasingly likely in some disciplines - to have had 1-2 years intensive postgraduate course-work prior to beginning their doctorates, class-work continues to occupy much of their time at the higher level. On average, half the total time taken to obtain the Ph.D. may be taken up in this way.

Surveying practices current in the early 1960s (Thompson, loc. cit., p. 61) found a wide-spread opinion that too much class-work was expected of students in some departments of the larger universities: "as long as a graduate class is offered, pressure is likely to be exerted to have students take it". The research work which fellows is increasingly regarded as the continuation of a process of training rather than a monumental addition to knowledge. To an increasing extent, also, the research work may be on an aspect of a more general problem upon which several students may be working under the same supervisor.

The official minimum duration of study leading to a doctorate is 3 years for a bachelor and 2 for a master. Not surprisingly, the actual duration is frequently much longer, and some anxiety has been expressed over the excessive times taken. A study by Stock and Beaulieu determined the time which had passed between receipt of bachelor's and doctor's degrees for scientists awarded the Ph.D. in 1959. Results were as follows:

1/4	4 or less years
1/2	5-9 years
1/4	10 or more years

These long periods of study are due less to students' incapacity as research workers than to over-heavy and distracting class-work and, possibly, to the concurrent employment of many students as teaching or research assistants. Thompson suggests that if time spent were reduced to full-time equivalent it would probably be quite near the official minimum. Also, some 60 per cent of students study in a university other than that of first graduation. This frequently requires a period of adaptation.

As Hatch and Rudd have pointed out in their study of postgraduate education in the United Kingdom (1), failure is a difficult concept to apply to doctoral work. Since such work has no fixed maximum duration, and students may register and re-register without necessarily making serious efforts to complete their theses, failure becomes an arbitrary concept. Since doctorates which are ultimately successful in Canada may last as long as 10 years, it is difficult to know after what period of time a student is actually unlikely in practice to obtain his Ph.D. Hatch and Rudd employed an arbitrary cut-off of 8 years, but this would be quite inapplicable in the Canadian situation. If 10 years were taken, then at least 25 per cent of students would be counted failures. In a sense, therefore, it can be said that this high "failure" rate is a result of the pressure of activities other than doctoral research. Although only 10 per cent of students are officially part-time, some 50-60 per cent are supported by means of research or teaching assistantships. Unfortunately we do not have any data on the time taken up by such duties, although it is possible that if we allow 50 per cent time for doctoral research, then such work may gradually replace course-work in the other 50 per cent as the student passes from his first to second and subsequent years.

(d) Contribution to Sectoral Research Effort

There are no data available for any country which enable an assessment to be made of the relative contribution made by postgraduate students in different disciplines. Although there are too many difficulties of a conceptual nature in the estimation of any contribution to knowledge, it is possible, simply in manpower terms, to estimate the contribution to the sectoral research effort. Using official estimates of the number of

(1) S. Hatch and E. Rudd: Graduate Study and After.

faculty, postdoctoral fellows and research students in the university system projected forwards to 1975-76, such an estimate is made in Table XIII.

TABLE XIII
STUDENT CONTRIBUTION TO RESEARCH IN UNIVERSITIES

Year	Numbers			Full-time Equivalents (1)			Contribution % by Students
	Faculty	Fellows	Students	Faculty	Fellows	Students	
1955-56	1,020	50	1,350	470	30	670	57%
1960-61	1,790	140	2,920	870	80	1,460	60%
1965-66	3,490	490	7,400	1,740	290	3,700	64%
1967-68	4,520	920	10,570	2,330	550	5,280	65%
1970-71	5,960	1,590	15,680	3,200	950	7,840	65%
1975-76	7,730	2,350	21,600	4,180	1,400	10,800	66%

(1) f.t.e. Faculty - official estimate
Postdoctoral fellows - on 60 per cent basis
Postgraduate students - on 50 per cent basis

The constancy after 1967-68 may reflect the means by which the figures, which were projections, were estimated. Nevertheless, it seems fairly clear that the growth of postgraduate education has resulted in university research being executed to an increasing extent by the students. Furthermore, the student contribution may be underestimated by the work which they do as research assistants - excluded from the 50 per cent estimate of time.

(e) Unorthodox Ph.D. Schemes

We are principally concerned here with any innovations in Ph.D. organisation designed in answer to specific needs or policies. It has already been pointed out that the typical Canadian Ph.D. is taken on a full-time basis in a university, and that because of the pressure of other activities it may take anything between 3 and 10 years. What divergencies from this pattern are to be found in Canada now?

The OECD report on Canadian science policy points to the very poor links to be found between university laboratories and those of industry and the Federal government (p. 302). How commonly is it possible for students to do their doctoral research work in a non-university laboratory? The OECD report finds that it is extremely uncommon, with the notable exception of a very few universities (p. 305):

"Only the goodwill of those in charge locally has occasionally made possible some mobility of staff and students, as at Dalhousie University (Nova Scotia) and more especially the University of Manitoba."

A number of universities (Saskatchewan should be added to the two referred to above) permit students to do their research in certain non-university laboratories on the campus. Such arrangements, though of obvious value when inter-sectoral links are weak, are still not common. The N.R.C. and the Fisheries Research Board, in particular, have actively encouraged the formation of such links in the past few years.

There is no documentary evidence of any substantial volume of Ph.D. work being carried out in industry, although this too may be of potential value.

V. OTHER POSTGRADUATE WORK

Thompson found that the master's degree in Canada suffers from its uncertain status, being on the one hand a certification of advanced study and on the other a milestone en route for the Ph.D. Programmes generally consist of class-work and a period of supervised intensive study, generally followed by a thesis. The thesis may embody a piece of research, or it may be an advanced essay; research is not always required. The average duration, which used to be around 1 year, is now nearer to 2. Thompson discovered the general feeling that the master's degree is declining in status and that the work required is deteriorating. This he attributes to the increasing popularity of doctoral work. The master's degree is often given to students who are in the process of taking doctorates, and frequently to those who are unable to obtain doctorates. This, to some extent, is a mark of failure rather than achievement. This is perhaps less true in applied subjects where the doctorate is not taken so frequently (1). Even so, many appear to be arguing for greatly expanded doctoral programmes in engineering and technologies, and the M.Sc. may decline in prestige in these disciplines too. This would be most unfortunate, and it is suggested in section VII that ways be found of improving the status of the master's degree.

VI. SUBSEQUENT EMPLOYMENT

While there is no regular collection of data on first employment of graduates, one or two ad hoc studies which have been carried out permit some insight into the employment preferences of Canadian recipients of the Ph.D. in science.

Stock and Beaulieu, in a study to which reference has previously been made, used a sample of 200 students who received their doctorates in science and engineering in 1960 and made a survey of their employment immediately subsequent to the receipt of their Ph.D. These data, analysed into different categories, are given below:

(1) The following are the sciences in which the ratio of master's enrolments to doctoral enrolments in 1966-67 exceeded the average (1.5 : 1): engineering and architecture, applied life sciences, geography, town planning and agricultural chemistry. Social sciences and humanities, in which this ratio exceeded its average (2.7 : 1), were commerce, English education, literature, social science (this is probably social administration), sociology, physical geography, religion and international affairs.

TABLE XIV
EMPLOYMENT OF 1960 Ph.D. RECIPIENTS IN SCIENCE AND ENGINEERING

%							
Further Study Home Abroad		Employment				Non- Canadians Returning Home	
		Home					Abroad
		University	Federal government	Industry	Other		
16 (N = 30)	16 (N = 31)	22	18	11	9	8 (N = 16)	(N = 35)

Note: percentages exclude non-Canadians returning home.

Thus, some 54 per cent of Ph.D. recipients remain in universities, 38 per cent of them remaining within the Canadian university system. Eleven per cent enter Canadian industry, whilst the other 9 per cent includes notably the employ of the provincial governments.

Thompson, taking the intuitive estimates of deans and chairmen of departments regarding subsequent employment of their graduate students (about half the universities keep employment records), was able to point out differences between the various disciplines. The data, which are given in Table XV, must be treated as very approximate, though useful nonetheless.

TABLE XV
ESTIMATED SECTORS OF EMPLOYMENT OF HIGHER GRADUATES (%)

	University	Government	Industry	Total
Chemistry	15	15	70	100
Physics	33	33	33	100
Geology	5	10	85	100
Agriculture		80		100
Biological sciences	about equal		very low	100
Engineering			great majority	100

Some breakdown by field is given in a study by Levine, though his survey reflects the intentions of currently (1967-68) enrolled students. The percentages below are no doubt a mean of preferences and interpretation of the employment situation: that is, the majority who hope for university employment could only be accommodated in a rapidly expanding university system. In Levine's data a distinction is made between students enrolled for the doctorate who hold the master's degree and those with only the bachelor's degree, and comparison between these two groups is of interest.

TABLE XVI
ANTICIPATED SECTOR OF EMPLOYMENT OF STUDENTS
ENROLLED FOR DOCTORATES 1967-68

(a) Holding a Master's Degree

	%				
	University	Government	Industry	Undecided	Total
Physical sciences	45.4	9.9	9.5	35.2	100 N = 748
Engineering	39.2	7.0	15.8	38.0	100 N = 329
Life sciences	62.4	23.5	1.6	12.5	100 N = 311
Psychology	56.6	6.4	0.0	37.0	100 N = 265
Other	40.5	48.7	0.0	10.8	100 N = 37
All	49.0	12.1	7.6	31.3	100 N = 1,690

(b) Holding a Bachelor's Degree

	%				
	University	Government	Industry	Undecided	Total
Physical sciences	49.3	5.1	17.8	27.8	100 N = 410
Engineering	28.0	4.0	25.3	42.7	100 N = 75
Life sciences	48.7	14.7	3.9	32.7	100 N = 156
Psychology	73.9	6.5	0.0	19.6	100 N = 46
Other	22.2	33.3	0.0	44.5	100 N = 9
All	48.1	7.6	14.1	30.2	100 N = 696

It would be reasonable to suppose that those who already hold a master's degree are, on average, more mature students with a better understanding of employment possibilities; however, total figures, which show that a higher proportion of masters are undecided, suggest that this is not the case. If it is a reasonable assumption nonetheless, then the increased uncertainty could be explained as follows.

There would seem to be an interlock of two opposed trends. In physical science and psychology, the more "realistic" students (i.e. those with master's degrees, if we preserve the hypothesis) show a reduced anticipation of a university career and increased indecision. This indicates that when an academic career appears unlikely there is no positive attraction elsewhere, certainly not to industry.

Life scientists and engineers would appear to have very different employment prospects. For them, realism brings increased anticipation, particularly of an academic career (for biologists, government employment is confirmed as an alternative option) and reduced indecision. The realism is confirmed for biologists, for their chances of an academic career to indeed seem to be greater than for physical scientists (see Table XV above). (Engineers with only a bachelor's degree are very few.) However, this high feed-back into the academic system may not be unrealistic: it has been shown that in 1960 the feed-back was about 38 per cent, and the universities have been expanding at a fairly constant rate ever since. Levine, in estimating the supply of new faculty in science,

PLACE OF Ph.D. VS. PLACE OF PRESENT EMPLOYMENT,
FOR THE SAMPLE WITH HIGHEST DEGREE (Ph.D.)

119

assumes a feed-back as high as 48 per cent of Ph.D.s and by counting in gains from elsewhere (e.g. migration) just meets his estimate of need by 1975-76 (1).

A further indication of Canadian academe's capacity to consume its young is given in Fig. I. At the same time, there is disquiet over the failure of Ph.D.s to enter industry. But this is a problem of policy rather than fact and will therefore be discussed in section VII.

A further dimension of the subsequent employment problem peculiar to federal countries is the place of subsequent employment. This is particularly important where provincial support of graduate studies is at issue. Some Canadian provinces have questioned the point of their contributing to the finance of graduate studies in the same way as they contribute to undergraduate studies, when in many cases 70 per cent of Ph.D.s leave the province. If higher education planning is a provincial responsibility, it becomes difficult, if not impossible, when emigration is of this order. In fact, the mobility of doctors is much greater than of masters, and the mobility of masters is greater than of bachelors. Table XVII shows the extent of this mobility. Only Ontario keeps a reasonable proportion of its Ph.D.s.

VII. POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM

Postgraduate education in Canada has grown rapidly over the past two decades, although postgraduates do not yet represent as high a percentage of total enrolments as in the United States of America or the United Kingdom. Doctorate enrolments are rising at around 20 per cent per annum - faster than master's or baccalaureate enrolments. Moreover, growth has been fastest in the arts and social sciences, such that whilst, in 1963-64, 1 in 2 advanced students were enrolled in the sciences, it has been estimated that this ratio will have fallen to 1 in 3 by 1975-76. Canada now awards annually about 1,200 Ph.D.s, 900 of them in the sciences and engineering. By 1975-76, Levine estimates that these figures will have risen to 3,100 and 2,000, respectively. Is it possible to comment on the appropriateness of this supply?

Recorded opinion in Canada on the supply of Ph.D.s does not seem to be of one mind. The Bladen Commission, reporting in 1965, thought that graduate students should be supported "on a scale that approaches the point of 'free education'" (2). Levine, also, considers that the present rate of growth in graduate studies in science and engineering "is well below the needs of Canada" (3). On the other hand, there is a widespread opinion that far too many Ph.D.s are being produced, and it has been predicted that the demand for science and engineering doctors in 1975-76 will be only half the supply (4). It is, however, particularly difficult to relate supply and demand in the Canadian case both because of the large number of non-Canadian graduate students (about 50 per cent at the doctoral level in science and engineering) and the large number of Canadians who receive their advanced training abroad. The OECD report on science policy in Canada suggested an over-supply of Ph.D.s (p. 295), although Dr. Solandt (Chairman of the Science Council) thought that the capacity of the economy to absorb graduates at this

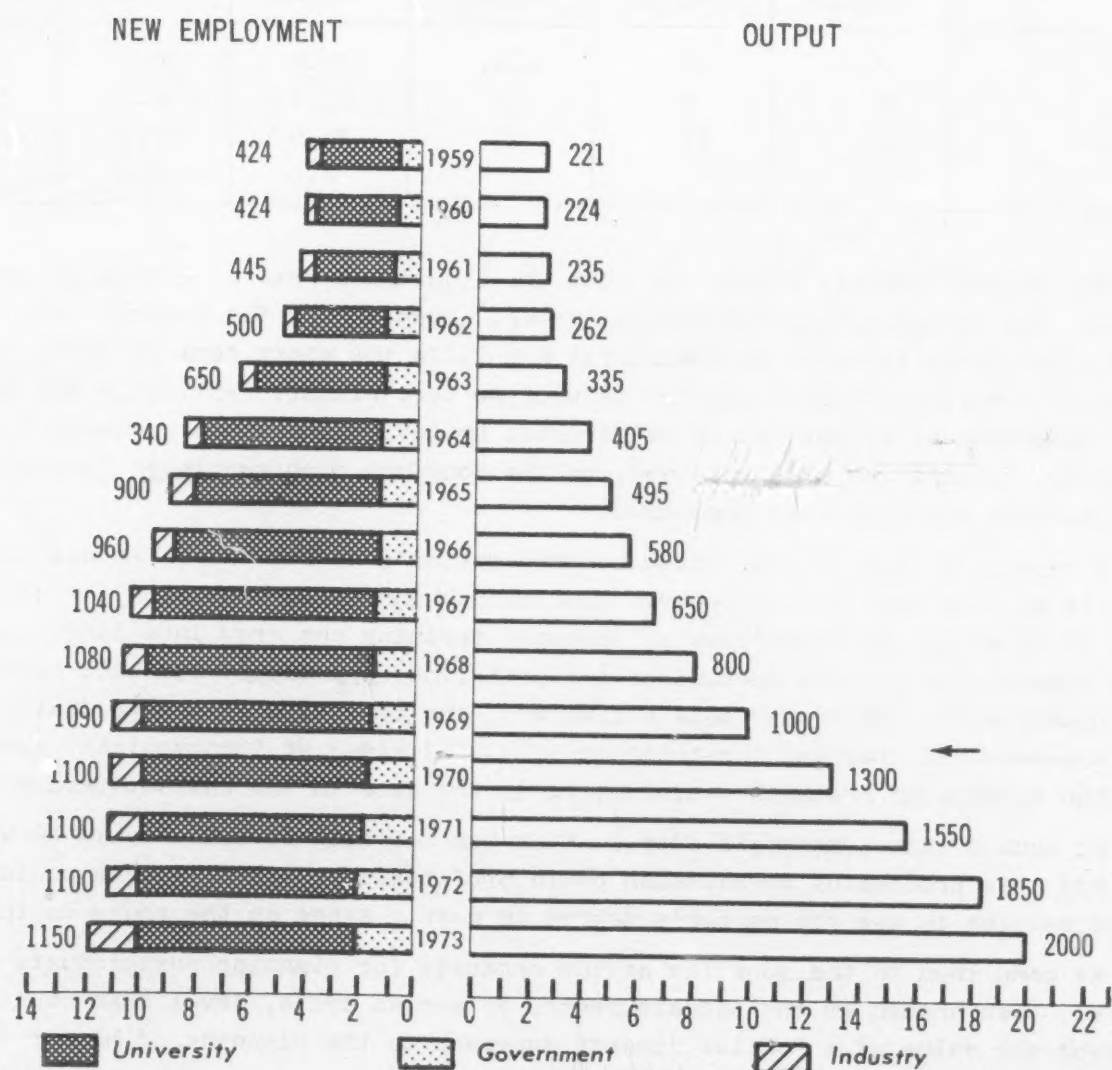
(1) But this is unrealistic because he neglects the high proportion of non-Canadians returning home.

(2) Bladen Commission, p. 65.

(3) Levine (1968) p. 3.

(4) Science Council: Special Study No. 7 (1969), p. 197.

Figure I
NEW EMPLOYMENT AND OUTPUT OF Ph. D's IN
SCIENCE AND ENGINEERING
(1959-1973)



Sources: The Senate of Canada, *Proceedings of the Special Committee on Science Policy*,
First Session, 28th Parliament, No. 3, p. 36.
Taken from *Reviews of National Science Policy : Canada (op. cit.)*.

level would grow (1). There is no doubt that this is a major problem of current Canadian scientific and educational policy.

From the question of the overall supply of, and need for, science Ph.D.s spring two other questions central to current Canadian policy debate. These are, on the one hand, the slow growth in industrial R & D (and hence the slow growth in demand for researchers on the part of that sector) and, on the other hand, the possibility of controlling the Ph.D. output.

To begin with the first of these issues. Over the past few years, the major expansion in the performance of R & D in Canada has been in the university and government sectors. This is brought out by Table XVIII below.

TABLE XVIII
DISTRIBUTION OF R & D EXPENDITURE

	% Annual Increases in Gross R & D Expenditure			Estimated Distribution of Expenditures in %		
	1967-68	1968-69	1969-70	1967-68	1968-69	1969-70
Industry	5.5	3	n.a.	39.4	35.2	33.2
Government	22	4	8	33.1	34.1	32.6
University	34	23	11	24.6	27.9	31.4
Other				2.9	2.8	2.8

The Science Council points out that the industrial rate of growth in expenditure is less than the inflation/sophistication factor. Even though the Council asks for a 20 per cent per annum increase in industrial R & D, in the short term it looks as though the demand of Canadian industry for Ph.D.s will be very slight. Whilst in the short-run the rapid expansion of higher education forecast by Levine, and the consequent faculty need, is likely to make use of the output, in the long-run such continued feed-back of doctorate holders could be very expensive.

A related problem is the status of the master's degree which, as has been pointed out, appears to have declined markedly. Even though increased provision for postgraduate education is of value, the provision of research training can grow in a dangerously unchecked fashion (if control mechanisms are deficient) and supply may well exceed the need for researchers. There may come a time when the provision of postgraduates with advanced non-research training (or training of a kind aimed at "conversion") must be promoted at the expense of research training, as is the case in the United Kingdom.

At such a time a master's degree which has not been devalued would be vital. Steps to end this process of devaluation could profitably be taken. There could be some utility in ceasing to use the master's degree to mark a stage on the route to the Ph.D.

We come then to the question of the capacity for planning postgraduate education in science. Even though at the baccalaureate, or second cycle, level, most countries would accept the value of a "social demand" approach to the planning of higher educational

(1) Dr. O.M. Solandt: Confrontation Meeting, Reviews of National Science Policy: Canada (op. cit.).

provision, in many cases economic constraints forbid this. At the postgraduate, and especially at the doctoral level, education becomes even more expensive. The Bladen Commission estimated that graduate students cost on average 3-4 times as much per capita as undergraduates (p. 26). Few countries can afford to let an increasing percentage of an increasing number of graduates go on to third cycle education, irrespective of the needs of the economy. Planning is generally possible to the extent that governments monopolise the sources of finance, although the possibility may be reduced where the monopoly is distributed between various agencies. The data of section II suggest that about 85 per cent of students receive some finance from an official source. However, federal agencies are responsible for only 50 per cent of this finance, provincial governments for another 15 per cent, and universities for 25 per cent. So far as science postgraduates are concerned, the N.R.C. may pay for some 40 per cent; but very few are financed solely from N.R.C. funds. Moreover, some 40 per cent of these are paid from research grants to their supervisors. It is to be doubted whether research grants and postgraduate grants can be allocated together on a single policy. This would only be possible if basic research grants were awarded in the light of national socio-economic requirements, from which flowed both basic science needs and manpower needs. The possibility of planning doctoral output would be much increased if federal responsibility for support were more concentrated, perhaps in three scholarship programmes (N.R.C., M.R.C. and Canada Council). However, this still leaves a certain responsibility on the provincial governments. The Macdonald Report recommends the continuance of this division of responsibility, but suggests that the federal authorities should give general subsidies towards the cost to the provinces of postgraduate education (p. 203). Clearly the division of responsibility for the finance of postgraduate education is a difficult problem in any federal country in which education is a state or provincial matter, and science a federal one.

SOURCES OF TABLES

Table I	(a) Thompson, to 1959-60, p. 32; Macdonald <u>et al.</u> , from 1959-60, p. 205. (b) Levine (1968) Table 2.
Table II	Thompson: Chapter 9; E.H. Stock and P.J. Beaulieu: "Science Postgraduates of Canadian Universities", <u>Canadian Public Admin. III</u> (4) (1960), p. 326. Quoted Thompson (<u>loc. cit.</u>).
Table III	Macdonald <u>et al.</u> : <u>Special Study No. 7</u> , Tables 10.8 and 10.10.
Table IV	<u>N.R.C. Annual Report</u> (1968-69) pp. 319-326.
Table V	<u>N.R.C. Annual Report</u> (1968-69) pp. 327-375.
Table VI	Levine (1968) Table 24.
Table VII	Levine (1968) Table 25.
Table VIII	Levine (1968) Table 27.
Table IX	N.R.C. Forecasting Committee (E.S.I.) Tables I, IV.A. <u>N.R.C. Report</u> , p. 16.
Table X	N.R.C. Office of Economic Studies: <u>Graduate Students</u> (1968-69).
Table XI	<u>Macdonald Report</u> , Table 10.5.
Table XII	Thompson, 1910-1950, p. 32; Bladen Report, 1960-63, p. 94; then OECD data.
Table XIII	N.R.C. Forecasting Committee (E.S.I.) Table I.
Table XIV	Stock and Beaulieu (<u>loc. cit.</u>), quoted Thompson, Chapter 10.
Table XV	Thompson, Chapter 10.
Table XVI	Levine (1968) Tables 16, 17.
Table XVII	<u>Macdonald Report</u> , Appendix 2, Table I.
Table XVIII	<u>Science Council Report</u> , p. 8.

BIBLIOGRAPHY

NATIONAL RESEARCH COUNCIL

1. Annual Report on Support of University Research, 1968-69 (Ottawa, N.R.C. No. 10784).
2. N.R.C. Forecasting Committee: "Expenditures on Research in Science and Engineering at Canadian Universities" (Economic Study ES1).
3. N.R.C. Office of Economic Studies on R & D: Graduate Students at Canadian Universities in Science and Engineering, 1968-69 (Ottawa, 1969).
4. O.H. Levine: "Graduate Students and Faculty Resources at Canadian Universities and Colleges" (1967, Economic Study ES2).
5. O.H. Levine: "Profiles and Characteristics of Graduate Students Enrolled for the Doctorate in Science and Engineering at Canadian Universities" (1968, Economic Study ES4).

SCIENCE COUNCIL OF CANADA

6. Third Annual Report 1968-69 (Ottawa, June 1969).
7. J.B. Macdonald, L.P. Dugal, J.S. Dupré, J.B. Marshall, J. Gordon Parr, E. Sirluck, E. Vogt: "The Role of the Federal Government in Support of Research in Canadian Universities". (Special Study No. 7, 1969).

OTHER

8. Commission on the Financing of Higher Education in Canada: Report (Bladen Report) (Toronto U.P. for Association of Universities and Colleges of Canada, 1965).
9. OECD: Reviews of National Science Policy: Canada (Paris, 1969).
10. W.P. Thompson: Graduate Education in the Sciences in Canadian Universities (Toronto U.P. 1963).

ANNEXE B

L'ENSEIGNEMENT UNIVERSITAIRE DE TROISIEME CYCLE EN FRANCE

TABLE DES MATIERES

	<u>Page</u>
I. <u>STRUCTURES ET EXPANSION DE L'ENSEIGNEMENT DE 3ème CYCLE ...</u>	130
(a) Organisation des études de 3ème cycle dans le système universitaire	130
(b) Evolution des effectifs inscrits en 3ème cycle et transfert depuis les cycles précédents	135
(c) Répartition géographique des effectifs et concen- tration des études de 3ème cycle	140
(d) Autres caractéristiques des effectifs de 3ème cycle	143
II. <u>RESSOURCES AFFECTEES A L'ENSEIGNEMENT DE 3ème CYCLE</u>	145
(a) Ressources financières	145
(b) Ressources en personnel	149
III. <u>PLACE RELATIVE DES FILIERES DE RECHERCHE ET DES AUTRES FILIERES D'ETUDES DANS L'ENSEIGNEMENT SUPERIEUR DE 3ème CYCLE</u>	153
IV. <u>LES DOCTORATS DE RECHERCHE</u>	153
(a) Les doctorats de spécialité	153
(b) Les doctorats "traditionnels"	157
(c) Contribution des études de doctorat à l'effort de recherche des universités	159
V. <u>LES AUTRES COURS DE 3ème CYCLE</u>	159
VI. <u>UTILISATION DES DIPLOMES DES ETUDES DE 3ème CYCLE</u>	162
VII. <u>PROBLEMES ACTUELS ET POLITIQUES DE REFORME</u>	164
ANNEXE. <u>INFORMATIONS COMPLEMENTAIRES SUR LA FORMATION DES CHERCHEURS (1964-65)</u>	168

Le plan commun établi pour les études de cas a été suivi dans la mesure du possible ; toutefois, étant donné l'extrême complexité des études de 3ème cycle en France, il a semblé nécessaire de donner une description de leur organisation ; de nombreuses difficultés et lacunes sont alors apparues :

- (i) la distinction entre les filières de recherche et les autres cours est très arbitraire ;
- (ii) depuis dix ans, ce cycle d'études a été affecté par de nombreuses réformes partielles, ce qui rend difficile l'évaluation de son fonctionnement réel ;
- (iii) il est difficile d'avoir une vue globale de ce fonctionnement qui est très variable selon les universités (et nécessiterait des enquêtes locales) ;
- (iv) enfin, en dehors des statistiques recueillies traditionnellement par le Ministère de l'Education nationale, les informations disponibles sont très limitées. Notamment on ne peut connaître :
 - les transferts depuis les premiers diplômes, la durée et le rendement de ces différentes études,
 - les formes d'aides financières aux étudiants (sauf quelques données sur les bourses attribuées en 1968-69 à 20 % d'entre eux),
 - la contribution de ces études à la recherche,
 - l'utilisation des diplômés dans l'économie.

I. STRUCTURES ET EXPANSION DE L'ENSEIGNEMENT DE 3ème CYCLE

(a) Organisation des études de 3ème cycle (1) dans le système universitaire

La complexité et la diversité, selon les facultés, des études de 3ème cycle exige une description préalable du cadre structurel dans lequel s'insère ce niveau d'études. Le schéma des études résulte d'une évolution historique propre à chacune des cinq facultés et marquée par une succession de réformes partielles ou de filières "ajoutées". Il doit se définir par référence aux traits majeurs du système universitaire français.

(i) Ce système est caractérisé par le dualisme existant entre : d'une part les cinq facultés dont la fonction traditionnelle est la diffusion d'une culture désintéressée et l'exercice de la recherche, et d'autre part les Grandes Ecoles dont la finalité est essentiellement professionnelle (2).

(ii) L'université - au sens étroit du terme - était constituée par une juxtaposition de cinq facultés (Droit et Sciences économiques, Lettres et Sciences humaines, Médecine, Pharmacie, Sciences) isolées les unes des autres et que la Loi d'orientation de 1968 s'est proposé de réorganiser.

Les conséquences de ces particularités majeures sur les études de 3ème cycle sont importantes :

- Les Grandes Ecoles, qui dans leur vocation traditionnelle avaient pour fonction de former des spécialistes en vue des besoins précis de l'industrie, ne dispensaient pas, jusqu'à une date récente, d'études de 3ème cycle. Ni leur fonction ni leur organisation n'ont permis de développer des activités de recherche orientées vers la formation de chercheurs (à l'exception des Ecoles normales supérieures). Or, ces Ecoles recrutent à la suite de sélections très sévères les meilleurs titulaires des baccalauréats de mathématiques (3) (et environ un tiers d'entre eux) attirés par le prestige conféré à

(1) L'expression 3ème cycle est prise ici dans un sens large, et sert à désigner l'ensemble des études postérieures aux premiers diplômes (licences, doctorats en médecine, diplômes de pharmacie). Elle correspond, dans la terminologie anglaise, au terme "postgraduate education". En français, la terminologie est très hésitante et variable et mériterait d'être uniformisée. On parle d'études conduisant au doctorat, ou aux grades supérieurs, d'études avancées ou d'études post-graduées, etc.

(2) Innovation dans l'enseignement supérieur - Expériences françaises avant 1968
OCDE (Paris 1970), page 33.

(3) Rapport Boulloche : Les conditions de développement, de recrutement, de fonctionnement et de localisation des Grandes Ecoles en France, p. 72, ministère de l'Education nationale, 1964.

ces institutions, ce qui a contribué à priver la recherche des étudiants (1) les plus doués.

- Les études de 3ème cycle constituent donc essentiellement le prolongement normal des premiers cycles des facultés qui ont ainsi le quasi-monopole de la formation des enseignants et des chercheurs. Cependant l'isolement et l'évolution particulière de chaque faculté a conduit à une organisation complexe (2) différente selon les branches d'études (à l'exception toutefois des facultés des Sciences, et des Lettres et Sciences humaines où le schéma des études est très voisin). Ces différences proviennent en partie des modifications de structures (ou de la création de certaines filières) qui ont affecté chaque faculté à des périodes différentes. D'une façon générale, ces réformes, et notamment la Réforme Fouchet de 1966, ont essentiellement modifié l'organisation des premiers cycles d'études, mais ceci n'a pas manqué d'avoir des répercussions sur le cycle supérieur.

1. Les études de 3ème cycle des facultés des Sciences

Jusqu'en 1966, la licence (d'enseignement ou libre) était obtenue à la suite d'une année propédeutique et de cinq certificats, obtenus en deux ou trois ans et donnait accès à plusieurs filières d'études ultérieures :

- le diplôme d'études supérieures (D.E.S.) qui permettait, en une année, un approfondissement des connaissances et constituait un préalable à la préparation de l'agrégation,
- le doctorat de spécialité (dit de 3ème cycle) créé en 1954 qui comporte une première année d'initiation à la recherche suivie, en deuxième année, de la préparation d'un travail de recherche dans l'une des cinq spécialités : mathématiques, physique, chimie, sciences biologiques ou sciences de la terre,
- le doctorat d'Etat qui est le grade universitaire le plus élevé et dont la préparation exige plusieurs années (quatre au minimum) et la soutenance d'une thèse principale. Sa possession permet d'être inscrit sur la liste d'aptitude à l'enseignement supérieur.

(1) Il faut cependant savoir qu'une proportion non négligeable (mais mal connue) d'étudiants s'orientent à leur sortie des Grandes Ecoles vers le doctorat de spécialité. Cette proportion semble s'être accrue depuis quelques années. De plus, certaines grandes Ecoles ont depuis deux ans créé leur 3ème cycle d'études.

(2) Un autre élément de complexité provient du fait que des termes identiques recouvrent des contenus et des niveaux de formation différents. Ainsi l'agrégation, qui en Sciences et en Lettres, n'est pas un grade universitaire mais un concours de recrutement des enseignants de niveau secondaire, est en Droit et en Médecine le titre de niveau le plus élevé destiné à recruter les enseignants de l'enseignement supérieur. Ce titre serait l'équivalent des doctorats d'Etat en Lettres et en Sciences, tandis que le doctorat d'Etat en Médecine constitue un premier diplôme.

Enfin, deux autres filières plus spécifiques :

- le doctorat d'université qui est un cycle de spécialisation court et comporte la préparation d'un mémoire en un ou deux ans (la majorité des inscrits à ce doctorat sont des étudiants étrangers),
- le diplôme d'ingénieur-docteur qui s'adresse aux titulaires d'un diplôme d'ingénieur et qui comporte la préparation en deux années de deux thèses portant sur les applications de la science.

Une première innovation importante a été introduite en 1964, dans les études de doctorat de spécialité avec la préparation, au cours de la première année, d'un diplôme d'études approfondies (D.E.A.). Ce diplôme sanctionne l'acquisition de connaissances dans le domaine de spécialisation choisi et permet de contrôler les aptitudes de l'étudiant dans sa discipline avant qu'il entreprenne les travaux de recherche conduisant à la rédaction de la thèse.

La réforme de 1966, qui a remplacé les certificats par des années d'études dans les premiers cycles, n'a pas fondamentalement modifié l'organisation des études de doctorat. Le D.E.S. a été supprimé ; la maîtrise a été créée qui se prépare en deux années à la suite du 1er cycle de deux années d'études et constitue un premier diplôme orienté vers la préparation à la recherche. Elle comporte la préparation de certificats, certains étant obligatoires, d'autres faisant l'objet d'un libre choix. Cette réforme, si elle affectait surtout les études conduisant aux premiers diplômes, se proposait donc d'établir - à l'issue d'un tronc commun de deux années (1er cycle) - une distinction très nette mais souple dans le 2ème cycle, entre :

- la préparation en une année aux fonctions enseignantes dans l'enseignement secondaire (licence),
- la préparation en deux années à la recherche (maîtrise).

La réforme proposait aussi une diversification des filières conduisant à la pratique de la recherche et des formations beaucoup plus liées aux besoins de l'industrie, en augmentant les possibilités de choix des thèmes de recherche du doctorat de spécialité ou du diplôme d'ingénieur-docteur.

Enfin, en 1968, la préparation du doctorat d'Etat était modifiée et pouvait dans certains cas être remplacée par la présentation d'un ensemble de travaux scientifiques originaux.

2. Les études de 3ème cycle des facultés de Lettres

Leur organisation est assez semblable à celle des études de sciences. Avant 1966, les titulaires d'une licence avaient la possibilité de préparer soit un D.E.S., exigé en vue de l'agrégation, soit un doctorat de 3ème cycle créé en 1958, fréquemment utilisé comme première étape vers le doctorat d'Etat, requérant en Lettres jusqu'à dix années de recherches solitaires, soit enfin un doctorat d'université.

Comme en Sciences, la réforme de 1966 a quelque peu affecté ce schéma d'études et en a modifié le contenu ; la création de la maîtrise - et la suppression du D.E.S. - devant permettre de distinguer et de diversifier la préparation à la recherche de l'orientation vers l'enseignement. Pour améliorer le niveau de formation des étudiants au cours de la première année de 3ème cycle, la participation à une direction de recherche et, dans quelques disciplines, la préparation d'un diplôme d'études approfondies (D.E.A) ont été exigées pour sanctionner l'acquisition de connaissances plus spécialisées. Enfin, depuis 1968, la durée de préparation du doctorat d'Etat a été réduite et l'utilisation des travaux de recherche autorisée, tandis que les modalités d'inscriptions dans le 3ème cycle étaient allégées.

3. Les études de 3ème cycle des facultés de Droit et de Sciences économiques

L'organisation actuelle de ces études résulte de la réforme de 1956, dont l'innovation essentielle avait été la création d'une licence ès sciences économiques, la durée des deux licences étant d'autre part portée de trois à quatre années. Cette réforme se proposait de revaloriser ainsi la formation juridique et économique afin de l'adapter aux exigences professionnelles. Les études postérieures aux licences proposaient jusqu'en 1963 une seule filière constituée par :

- le diplôme d'études supérieures d'une année (quatre options en Droit, une en Sciences politiques, une en Sciences économiques) d'approfondissement des connaissances (cours et travaux pratiques) et d'initiation à une recherche (rédaction d'un mémoire). Ce diplôme constitue souvent la première partie du doctorat d'Etat qui consiste en la rédaction et la soutenance d'une thèse dans l'un des six domaines précédents ;
- la préparation au concours d'agrégation qui assure le recrutement des enseignants de l'enseignement supérieur. En 1969, les épreuves de ce concours de haut niveau étaient allégées tandis que les travaux du candidat étaient pris en considération.

Depuis 1963, un doctorat de spécialité - semblable à celui des facultés des Lettres - a été créé ; il "consacre la possession des connaissances approfondies et la formation au maniement des méthodes de recherches".

4. Les études médicales

Elles ont été l'objet de profondes modifications introduites en plusieurs étapes au cours des deux dernières années. La réforme de 1958 visait à supprimer la division entre la carrière universitaire et la carrière hospitalière qui compromettait le développement de la recherche biologique et médicale au seul profit d'une recherche clinique isolée, et à concilier les caractères universitaires et professionnels de l'enseignement. La création dans chaque ville universitaire d'un centre hospitalier universitaire (C.H.U.) dont les activités sont centrées conjointement sur les soins, l'enseignement et la recherche ont permis une intégration de toutes ces fonctions et notamment une réorganisation de la recherche. Celle-ci repose sur :

- la création d'un 3ème cycle d'études et de recherches en biologie humaine qui exige la préparation d'un diplôme d'études approfondies (D.E.A.) de biologie humaine (délivré aux titulaires de la maîtrise, et d'un certificat d'études supérieures préparatoires au D.E.A.), et la soutenance d'un mémoire à l'issue d'un stage de deux années dans un laboratoire agréé. Le D.E.A. conduit à la préparation d'un doctorat d'Etat en biologie humaine ;
- l'organisation de la recherche dans les C.H.U. a été rendue possible à la suite de regroupements et de l'intégration de laboratoires de recherches biologiques aux C.H.U. Elle repose sur une collaboration étroite entre les chercheurs, les cliniciens et les fondamentalistes. D'autre part, une fusion de la recherche pharmaceutique et dentaire à la recherche médicale et biologique a été opérée en annexant les laboratoires des anciennes facultés de pharmacie ou écoles dentaires aux C.H.U.

En plus des activités de recherches, les études médicales avancées (médecine, pharmacie et études dentaires) se caractérisent toujours par la préparation de certificats d'études supérieures spécialisées (C.E.S.) d'une grande diversité en vue d'acquies une spécialisation plus poussée. La préparation à l'agrégation pour le recrutement du corps enseignant des facultés, a été modifiée par suite de la réforme de l'internat. Des internes recrutés au niveau national (les "résidents") peuvent être nommés chefs de clinique puis accéder aux fonctions de maîtres de conférence et de professeurs agrégés en fonction de leurs travaux.

En résumé de cette description complexe, on peut considérer que les études universitaires de 3ème cycle se caractérisent par la juxtaposition (ou la superposition) de deux systèmes ;

(i) un système traditionnel dont la première étape était au-delà de la licence la préparation du diplôme d'études supérieures (1). A l'issue de cette année intermédiaire, la plupart des titulaires se consacraient :

- soit à la préparation de l'agrégation (recrutement de l'élite des professeurs de l'enseignement secondaire) ;
- soit à la rédaction d'une thèse (exigeant de trois à dix années) dont la soutenance conférait, avec le titre de docteur d'Etat :
 - un statut académique très élevé ;
 - la possibilité d'obtenir à vie une chaire universitaire.

(1) Jusqu'en 1966 en Sciences et en Lettres

La fonction de ce cycle d'études est donc très étroitement spécialisée et permet essentiellement d'assurer le renouvellement, par une sélection rigoureuse, du corps enseignant.

- (ii) une filière de préparation à la recherche (doctorats). Les doctorats de spécialité, dont la création a été justifiée par les besoins en personnel de recherche a été "ajoutée" et en partie intégrée au système traditionnel. Ce doctorat constitue souvent la première phase de la préparation au doctorat d'Etat.

Le doctorat de spécialité a permis de conférer aux études de 3ème cycle une fonction de recherche qui - en Sciences notamment - tend à devenir primordiale. Mais cette innovation n'a pas été généralisée à toutes les autres facultés : au contraire, elle a été étendue en différentes étapes en fonction, semble-t-il, de l'urgence du besoin de développement de la recherche. Les étapes successives de la mise en place de cette filière de recherche ayant été :

- la création du doctorat de spécialité en Sciences (1955) ;
- son extension en Lettres et Sciences humaines (1958), puis en Droit et Sciences économiques (1965) ;
- la réforme des études médicales (1959-1969) ;
- la distinction entre la licence et la maîtrise en Sciences et en Lettres (1966).

On doit ajouter que, conformément aux traditions universitaires :

- (i) les diplômes n'ont qu'une valeur académique (à l'exception des titres conférant l'aptitude à enseigner) ;
- (ii) les organismes de recherche - même ceux qui fonctionnent en étroite relation avec les universités - n'ont ni les moyens ni les attributions de former des chercheurs (même si certains utilisent leurs travaux de recherche pour obtenir des grades universitaires supérieurs).

(b) Evolution des effectifs inscrits en 3ème cycle et transfert depuis les cycles précédents

1. Effectifs et répartition par branches d'études (facultés)

L'expansion rapide qui a affecté l'enseignement universitaire à partir de 1955 s'est évidemment répercutée au niveau des études de 3ème cycle vers 1958-59. Les statistiques d'effectifs (tableau I) font apparaître que de 1958-59 à 1966-67 :

- la place relative de ces études dans l'ensemble de l'enseignement universitaire s'est très sensiblement accrue ;
- l'accroissement des effectifs y a donc été à peine plus rapide que dans les premiers cycles d'études.

CALENDRIER DES REFORMES DE L'ENSEIGNEMENT
SUPERIEUR DE 3ème CYCLE

Facultés	Réformes des premiers cycles	Répercussion sur les études de 3ème cycle ou réformes	Années de création des doctorats de spécialité
Sciences	1966 - Création de deux cycles d'études :		1954
	- 1er cycle de 2 ans		
Lettres et Sciences humaines	- 2ème cycle conduisant soit : à la licence (en 1 an) à la maîtrise (en 2 ans)	Suppression du diplôme d'études supérieures (D.E.S.)	1958
Droit et Sciences économiques	1954 - Licence en 4 années 1959 - Création d'une licence en Sciences économiques	Création du D.E.S. du doctorat et de l'agrégation en Sciences économiques	1963
Médecine	1959 - Création des C.H.U. à 1969 - Cycles d'études de Biologie humaine - Participation à la vie hospitalière	Regroupement de la recherche en Sciences médicales Création d'un doctorat de spécialité de Biologie humaine	

TABLEAU I

EFFECTIFS DES ETUDES DE 3ème CYCLE (1)

	1958-1959	1966-1967	Taux d'accroissement annuel moyen (%)
A. Effectifs du 3ème cycle	18.400	49.250	13,1
B. Effectifs de l'enseignement universitaire	186.101	458.409	11,9
B/A (%)	9.03	10.7	-

(1) Les sources de tous les tableaux (sans référence précise) sont les publications du Ministère de l'Education Nationale de la série "Statistiques des enseignements : tableaux et informations".

En fait, ces données n'ont une signification que rapportées à chacune des cinq facultés.

TABLEAU II

REPARTITION DES EFFECTIFS DU 3ème CYCLE

SELON LES FACULTES

	En pourcentages des effectifs totaux de chaque faculté		En pourcentages du total des effectifs de 3ème cycle	
	1958-1959	1966-1967	1958-1959	1966-1967
Sciences pures	5.1	14.5	18.6	37.1
Sciences médicales	18.9	21.7	41.6	23.7
Droit et Sciences économiques	10.5	7.3	21.4	13.0
Lettres et Sciences humaines	5.5	8.4	18.3	26.0
			100.0	100.0

Le tableau II montre que :

- la place relative de ces études est très variable selon les facultés. En 1966-67, de 15 % à 20 % des effectifs des facultés scientifiques (1) étaient inscrits à ce niveau d'études contre moins de 10 % dans les autres facultés ;

- au cours de la période, ces proportions ont augmenté rapidement en Sciences pures, et plus lentement en Lettres, en Médecine, et ont nettement diminué en Pharmacie et en Droit. La répartition des étudiants s'est donc modifiée dans le sens d'une extension très marquée des enseignements de 3ème cycle de Sciences pures, ce qui constitue un élément important de l'évolution de ce niveau d'études et de ses fonctions.

2. Transferts depuis les cycles précédents

L'accroissement continu des flux annuels de nouveaux entrants au cours de la période 1956-1966 a évidemment modifié la répartition des effectifs universitaires au profit des premiers cycles. Aussi, l'extension des études de 3ème cycle ne peut être correctement reflétée par les proportions des effectifs totaux inscrits à ce niveau d'études.

La mesure des taux de transfert des titulaires des premiers diplômes vers le 3ème cycle d'études universitaires permettrait de saisir le développement de ce cycle à l'intérieur de la structure universitaire. Les statistiques actuelles ne permettent pas de faire ce calcul : à titre indicatif, on a rapporté (tableau III) les effectifs inscrits à l'ensemble des premiers diplômes délivrés au cours des trois années précédentes. On peut supposer que ces indices, qui ne sont en aucun cas des taux de transferts, seraient approximativement proportionnels à ces derniers et auraient enregistré la même évolution.

TABLEAU III

RAPPORT DES EFFECTIFS DE 3ème CYCLE
AUX PREMIERS DIPLOMES DES TROIS ANNEES
PRECEDENTES

	1956-1957	1962-1963	1966-1967
Sciences pures	51.1	73.3	97.4
Sciences médicales	59.5	76.8	87.6
Droit et Sciences économiques	72.8	76.8	76.5
Lettres et Sciences humaines	34.6	48.4	57.4

(1) En médecine, les inscriptions à plusieurs certificats de spécialisation entraînent des doubles comptes.

On peut donc estimer - sans pouvoir toutefois les évaluer (1) - que les taux de transfert :

- auraient doublé en Sciences pures ;
- se seraient accrus des deux tiers en Lettres et Sciences humaines et en Sciences médicales ;
- seraient restés constants en Droit.

3. Répartition des effectifs de 3ème cycle par type d'études et de diplômes préparés

La modification de la répartition des effectifs de 3ème cycle entre les facultés et leur extension rapide en Sciences est très étroitement dépendante des changements intervenus dans le choix des différentes filières de formation. Dans ces facultés ainsi qu'en Lettres et Sciences humaines, c'est la mise en place et le développement rapide des doctorats de spécialité de préparation à la recherche aux dépens des filières traditionnelles (D.E.S.) qui expliquent les changements d'orientation des étudiants et la modification du contenu de ces études, comme le montre le tableau suivant :

- (1) Le rapport général de la Commission d'équipement scolaire du V° Plan (1966-1970) a fixé (dans le cadre de la nouvelle structure des facultés des Sciences et des Lettres) à 35 % la proportion des titulaires de la maîtrise en Sciences qui entreprendraient un doctorat de spécialité (17,5 % en Lettres). Les répartitions des effectifs souhaitées en 1970 seraient les suivantes :

	1er cycle	2ème cycle (licences et maîtrises)	3ème cycle
Sciences	58.2	30.2	11.6
Lettres et Sciences humaines	61.3	32.9	6.8
et dans les autres facultés, à cette même date :			
Droit et Sciences économiques	Licences : 85.0 3ème cycle: 15.0		
Médecine	1ère à la 6ème année : 70.0 Spécialisations : 30.0		

TABLEAU IV
REPARTITION DES EFFECTIFS DE 3ème CYCLE
SELON LES TYPES DE DIPLOMES PREPARES

		1960-1961	1966-1967
Sciences	D.E.S.	28.1	11.0
	Doctorats de spécialité	26.6	49.2
	Autres doctorats	44.9	39.8
		100.0	100.0
Lettres et Sciences humaines	D.E.S.	72.9	63.2
	Doctorats de spécialité	8.7	23.9
	Autres doctorats	18.4	12.9
		100.0	100.0

(c) Répartition géographique des effectifs et concentration des études de 3ème cycle

La mesure de la répartition géographique des effectifs de 3ème cycle entre les universités n'est qu'un indicateur très imparfait du degré de spécialisation de certaines universités, ou de concentration de ces études dans quelques centres.

La tradition universitaire a fait de Paris un centre où restent fortement concentrées les études scientifiques de 3ème cycle. Au cours des dernières années cette situation s'est quelque peu modifiée avec le développement des universités de province, dans le sens d'une dispersion des enseignements entre ces universités.

TABLEAU V
REPARTITION GEOGRAPHIQUE DES
EFFECTIFS DU 3ème CYCLE (A)
ET DE L'ENSEMBLE DES EFFECTIFS UNIVERSITAIRES (B)

Universités (1)	Sciences		Médecine		Lettres	
	1962-63	1966-67	1962-63	1966-67	1962-63	1966-67
Paris : A	44.1	39.5	52.6	41.4	33.5	35.3
B	29.0	27.7	33.6	32.7	32.5	29.9
2 plus impor- A	11.6	13.0	15.0	20.0	12.3	14.8
tantes uni- B	9.4	12.8	14.0	16.0	11.8	10.6
versités de province						
20 autres uni- A	41.3	47.5	32.4	38.6	35.1	45.8
versités B	61.6	60.0	51.6	51.3	54.6	56.7

(1) Cette distinction se réfère à la configuration universitaire antérieure à celle résultant de l'application de la Loi d'orientation universitaire de 1968.

Si l'on considère la répartition des seuls effectifs des doctorats de spécialité - qui constituent un meilleur indicateur de concentration des filières de préparation à la recherche - on relève les mêmes tendances :

TABLEAU VI
REPARTITION DES EFFECTIFS DU DOCTORAT DE
SPECIALITE

	Sciences		Lettres	
	1962-1963	1966-1967	1962-1963	1966-1967
Paris - Centre	33.9	29.0	45.5	32.4
- Périphérie	(1) 11.0	11.7	(2) -	7.1
2 plus importantes universités de province	14.8	13.0	27.0	15.0
20 autres universités	40.3	46.3	27.5	55.5

(1) Orsay
(2) Nanterre

Ces quelques données font donc apparaître :

- une concentration assez forte mais ancienne des études de 3ème cycle dans la capitale et qui s'est un peu atténuée au cours de la période considérée ;
- une assez forte dispersion dans toutes les autres universités. En particulier, malgré le prestige de certaines universités provinciales, il ne semble pas que tende à se constituer un regroupement des activités de préparation à la recherche (du moins jusqu'en 1966) (1).

(1) Les propositions faites dans ce sens sont souvent contradictoires :

- (i) soit qu'il apparaisse souhaitable à certains d'associer chaque enseignement universitaire à des activités de recherche afin de ne pas séparer les deux fonctions ;
- (ii) soit qu'une concentration des études de 3ème cycle dans les instituts de hautes études (à l'image des Institutes for Advanced Study américains) semble un moyen de parvenir à une plus grande efficacité et à une meilleure utilisation des ressources. Cette deuxième solution était retenue par les responsables du Plan qui souhaitaient une concentration et une spécialisation de la recherche dans les métropoles d'équilibre et par les participants au Colloque de Caen (Colloque sur l'Enseignement supérieur scientifique et la Recherche, page 74, Caen 1966).

(d) Autres caractéristiques des effectifs de 3ème cycle

1. Origine sociale des étudiants (1966-1967)

Par rapport à la répartition de l'ensemble des effectifs universitaires selon les catégories socio-économiques d'origine, des différences substantielles apparaissent. La catégorie "professions libérales et cadres supérieurs" est en effet sur-représentée par rapport à la distribution du total des étudiants aux dépens des autres catégories et essentiellement de la catégorie "ouvriers", comme le montre le tableau suivant :

TABLEAU VII

ORIGINE SOCIALE DES ETUDIANTS

DE 3ème CYCLE

(Pourcentage)

	Sciences	Droit	Lettres
<u>Professions libérales et cadres supérieurs : 3ème cycle</u>	35.0	42.6	35.7
Total de la faculté	28.5	34.0	28.2
<u>Ouvriers : 3ème cycle</u>	10.2	3.9	6.1
Total de la faculté	12.9	8.7	11.4

2. Répartition selon le sexe

Comme le montre le tableau VIII, les proportions de femmes poursuivant des études au-delà du premier diplôme sont nettement inférieures aux proportions de titulaires de ce diplôme. Dans ce domaine aussi, l'accès au 3ème cycle d'études universitaires donne lieu à des processus de sélection qui accusent les disparités existantes au niveau des premiers cycles.

TABLEAU VIII
PARTICIPATION FEMININE AUX ETUDES
DE 3ème CYCLE 1967-68

	(pourcentages)	
	1er diplôme des trois années précédentes	3ème cycle
Sciences	31.1	21.1
Médecine	34.4	29.0
Droit	23.8	20.2
Lettres	62.1	56.0

3. Proportions d'étudiants étrangers

Ces proportions sont en moyenne deux fois plus élevées que les proportions enregistrées dans les premiers cycles d'études, avec toutefois des différences importantes selon les facultés (tableau IX).

TABLEAU IX
PROPORTIONS D'ETUDIANTS ETRANGERS

1966-67

(en pourcentage du total des inscrits)

	Dans le 3ème cycle	Dans l'ensemble de l'enseignement universitaire
Sciences	10.7	5.4
Médecine et Pharmacie	8.5	8.1
Droit	20.4	5.6
Lettres	30.6	6.7
Total :	13.7	6.4

Le fait que les proportions les plus élevées se rencontrent dans les facultés "non scientifiques" correspond peut-être à une préférence pour les études littéraires ou juridiques de la part de ces étudiants. Il résulte sans doute aussi en partie du prestige moins marqué des facultés scientifiques françaises (par rapport à celui d'universités d'autres pays).

II. RESSOURCES AFFECTÉES A L'ENSEIGNEMENT DE 3^{ème} CYCLE

(a) Ressources financières

Les documents budgétaires (1) ne permettent pas de mesurer même approximativement le montant des ressources financières affectées aux études de 3^{ème} cycle. A l'exception de certaines formes d'aides aux étudiants (bourses et allocations d'études), l'affectation des crédits est faite selon la nature des dépenses sans distinction des cycles d'enseignement auxquels ils sont attribués. Cette distinction serait d'ailleurs fonctionnellement impossible puisque les ressources disponibles (en personnel ou en équipements) sont utilisées indistinctement aux différents niveaux des études universitaires à des usages divers. Ainsi, les équipements consacrés à la recherche ne sont que partiellement utilisés en vue de la formation des chercheurs.

1. Les dépenses de recherche

L'évolution de certaines catégories de dépenses courantes de l'enseignement universitaire, si elle ne permet pas de préciser le coût des études de 3^{ème} cycle, fournit quelques informations indirectes. Le tableau suivant mentionne à titre indicatif la répartition par catégorie et par faculté des dépenses de recherche en 1968.

On notera que les facultés scientifiques absorbent les trois quarts du total des crédits de recherche affectés aux universités dont plus de 50 % aux facultés des Sciences ; le coût recherche par étudiant étant dans ces facultés cinq fois supérieur à celui des facultés à vocation non scientifique. Enfin, environ 80 % de ces dépenses étaient affectés à la rémunération du personnel, dont 50 % au seul personnel enseignant.

Les dépenses de recherche prises en considération dans ces calculs excluent les subventions versées par d'autres organismes (ce qui aurait faussé la comparaison des coûts à l'étudiant). L'évaluation globale de ces dépenses est précisée au tableau XI selon l'organisme de financement. Ainsi, en 1968, 70 % de ces ressources étaient affectées au titre de la subvention de fonctionnement du Centre national de la Recherche scientifique. On estimait à cette date qu'environ les trois cinquièmes servaient à couvrir les dépenses en personnel.

(1) Le système de financement de l'enseignement et l'évolution des dépenses publiques sont exposées dans : Examen des politiques nationales en matière d'enseignement - France, tome 1, ch. III - OCDE - 1972.

TABLEAU X

COUT ET RECHERCHE DANS LES UNIVERSITES ET FACULTES (1968)

Disciplines	Effectifs étudiants	Fonction- nement la- boratoires de recher- che	P e r s o n n e l				Prime de recherche scienti- fique	TOTAL RECHERCHE	Coût moyen recherche à l'étudiant
			Traite- ments ensei- gnants	Traite- ments person- nels techni- ques	Indemnités de résidence	Charges sociales correspon- dantes			
		36-15/2	31-11	31-15	31-91	33-91	36-22		
Droit	119 000	2 143	21 110	1 635	4 094	1 965	1 680	32 627	274
Lettres	182 000	5 625	67 700	3 276	12 734	5 790	8 370	103 495	568
Médecine- Pharmacie	94 000	26 206	75 860	8 870	16 555	7 266	3 130	137 887	1 466
Sciences	140 000	90 312	124 000	23 757	25 024	14 199	19 150	296 442	2 117
TOTAL	535 000	124 286	288 670	37 538	58 407	29 220	32 330	570 451	1 066

Source : Coût à l'étudiant en 1968. Ministère de l'Education nationale, Paris.

TABLEAU XI
EVOLUTION DES CREDITS DE LA RECHERCHE UNIVERSITAIRE

	1962	1968
Subvention du CNRS	200.000	567.000
Subvention aux universités	70.000	225.000
Autres	30.000	24.000
TOTAL	302.000	816.000

Source : Examen des politiques nationales en matière d'enseignement - France,
op. cit.

Ces dépenses incluaient, outre la rémunération du personnel enseignant et technique, la rétribution des services de "collaborateurs ou vacataires" dont la majorité était des étudiants préparant un doctorat de spécialité. Toutefois, le montant de cette contribution spécifique à la formation des chercheurs et au financement des études de 3ème cycle ne peut être évalué.

2. Les crédits d'aide (en espèces) accordés aux étudiants poursuivant des études de 3ème cycle constituent la seule catégorie de dépenses consacrées à ce niveau d'études susceptible d'être évaluée de façon précise. Trois formes d'aide sont octroyées :

- (i) les bourses proprement dites attribuées en fonction du niveau des ressources familiales ;
- (ii) les allocations d'études de 3ème cycle réservées aux étudiants préparant un doctorat de spécialité et accordées pendant deux années. Jusqu'en 1969-70, elles étaient attribuées à tous les étudiants qui en faisaient la demande. Depuis cette date, des restrictions tendent à être apportées par suite de l'augmentation du nombre de demandes ;
- (iii) les bourses d'agrégation accordées pour une année de préparation à ce concours et accordées sur demande jusqu'en 1969-70, quelles que soient les ressources familiales.

En 1968-69, le nombre d'étudiants bénéficiaires de chacune de ces formes d'aide directe était le suivant :

TABEAU XII
NOMBRE DE BENEFICIAIRES D'AIDES (EN ESPECES)
ATTRIBUEES AUX ETUDIANTS DE 3ème CYCLE
(1968-69)

	Bourses	Allocations d'études		Bourses d'agrégation	Total
		1ère année	2ème année		
Sciences	1 385	1 934	1 143	666	5 128
Médecine	236	-	-	-	236
Droit	1 089	51	13	3	1 156
Lettres	1 385	214	218	1 953	3 770
Total enseignement public	4 095	2 199	1 334	2 622	10 290
Total enseignement privé	11	24	4	-	39
TOTAL	4 106	2 223	1 378	2 622	10 329

En 1968-69, 21 % des effectifs du 3ème cycle recevaient une aide directe publique, soit une proportion d'étudiants voisine de celle des cycles précédents. En ce qui concerne les seules allocations d'études aux étudiants de doctorat de spécialité, en étaient bénéficiaires (environ) :

- 25 % des inscrits en Sciences
- 11 % des inscrits en Lettres et Sciences humaines
- 9 % des inscrits en Droit et Sciences économiques

Pour cette même année, sur la base des taux annuels moyens de chacune de ces trois formes d'aide, le montant des crédits de bourses pourrait être évalué à 44.256 francs (1), soit 17,4 % du montant total des prestations en espèces accordées aux étudiants.

(1) Sont exclus les bourses accordées par les Services publics aux étudiants préparant les concours de recrutement de la fonction publique ainsi que les traitements des élèves-professeurs préparant l'agrégation.

TABLEAU XIII
MONTANT DE L'AIDE PUBLIQUE DIRECTE
AUX ETUDIANTS DE 3ème CYCLE
(1968-69)

	Taux annuels (en francs)	Nombre de bénéficiaires	Crédit (en 000 francs)
Bourses	3 060	4 106	12 564.4
Allocations d'études (1ère année)	4 734	2 223	10 523.7
(2ème année)	5 292	1 378	7 292.4
Bourses d'agrégation	5 292	2 622	13 875.4
		10 329	44 256.1

Au cours des dernières années, le nombre de ces bénéficiaires ne semble pas avoir augmenté. Il était de 14.150 en 1967-68, mais de 10.300 seulement en 1968-69 à la suite de compressions budgétaires.

Toutefois, il faut rappeler qu'une proportion importante et certainement croissante d'étudiants de ce niveau reçoit une rémunération directe pour des services effectués, tels que :

- services d'enseignements (moniteurs ou assistants)
- services de recherche ("vacataires" ou collaborateurs techniques)
- services hospitaliers pour les étudiants en médecine (externat ou internat), etc.

Mais le montant de ces aides indirectes aux étudiants de 3ème cycle ne peut être évalué.

(b) Ressources en personnel

L'évaluation des ressources en personnel enseignant affectées aux études du 3ème cycle serait - si elle était possible - tout aussi arbitraire que celle des ressources financières. La plupart des enseignants exercent leur fonction dans les différents cycles d'études et consacrent aux activités de recherche une part de leur

temps (1) dont une fraction peut être affectée à la formation des chercheurs préparant sous leur direction un doctorat de spécialité. D'autre part, une proportion non négligeable (environ 1/4 en Sciences) des directions de recherche (Séminaires de formation des étudiants de doctorat) est assurée par des directeurs ou des maîtres de recherche du C.N.R.S.

La Commission de l'équipement scolaire et universitaire du Vème Plan (1966-1970) avait évalué - afin de fixer les besoins en personnel enseignant (et les effectifs à recruter) - des normes d'encadrement du doctorat de spécialité. Celles-ci pour être très approximatives méritent d'être rappelées (2). Pour chaque groupe de 25 étudiants à raison de quatre heures de cours par semaine, les normes d'encadrement et le personnel utilisé étaient les suivants (dans les facultés des Sciences) :

TABLEAU XIV

PERSONNEL ENSEIGNANT DANS LE 3ème CYCLE :
DOCTORAT DE SPECIALITE (SCIENCES), 1965

Statut	Normes d'encadrement	Effectifs d'enseignants (total)	Pourcentage du total des enseignants affectés aux études de 3ème cycle
I. Supérieur (professeurs et maîtres de conférences)	1.33	352	22.1
II. Moyen (maîtres-assistants)	0.44	116	4.9
III. Inférieur (assistants)	0.89	236	6.1

- (1) L'évaluation du temps des enseignants universitaires consacré aux activités de recherche se fait de la façon suivante :
- la moitié du temps de travail pour les enseignants des facultés des Sciences ;
 - un tiers pour ceux des facultés de Médecine ;
 - un quart pour ceux des facultés de Lettres.

- (2) Rapport général de la Commission de l'équipement scolaire, universitaire et sportif, 4ème partie, chapitre V. Ministère de l'Education nationale, Paris.

TABLEAU XV

PERSONNEL ENSEIGNANT PAR STATUT ET PAR FACULTE
(Total)

Sciences				Médecine				Lettres et Sciences humaines				Droit et Sciences économiques				
	I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total
1957-58	312	417	1 196	1 925	717	546	813	2 076	266	288	255	809	261	130	131	522
1967-68	626	1 287	7 496	9 409	878	1 578	5 226	7 682	396	772	2 739	3 907	392	844	993	1 729

Total				
	I	II	III	Total
1957-58	1 556	1 381	2 395	5 332
1967-68	2 223	3 081	16 454	22 727

Sources : Le personnel enseignant et l'expansion de l'enseignement dans les pays Membres depuis 1950
(Conférence sur les politiques d'expansion de l'enseignement, vol. V), OCDE, Paris, 1971.
Evolution quantitative du personnel enseignant dans l'enseignement supérieur
(Conférence sur les politiques d'expansion de l'enseignement), OCDE, Paris 1971.

En Lettres, les normes d'encadrement étaient identiques, à savoir qu'un groupe d'étudiants de doctorat (4 heures de cours hebdomadaires) exigeait quatre heures de cours d'un enseignant de statut I bénéficiant de la collaboration d'un enseignant de statut II (à concurrence des deux tiers) et d'un enseignant de statut III (à concurrence d'un tiers). Enfin, en Droit, les normes d'encadrement par groupe de 300 étudiants (1) étaient les suivantes⁷ :

Statut		Pourcentages du total des enseignants
I	7.8	35.0
II	7.0	40.0

Ces critères d'encadrement sont nécessairement approximatifs et ne concernent que quelques filières de 3ème cycle.

Pour pallier ces lacunes statistiques, on mentionnera à titre indicatif l'évolution des effectifs du personnel enseignant ainsi que celle des effectifs de chercheurs par faculté. On rappellera que la majorité des enseignants de statut inférieur (assistants et maîtres assistants) sont engagés dans des études de 3ème cycle (préparation des doctorats de spécialité et surtout des doctorats d'Etat).

TABLEAU XVI
EVOLUTION DES EFFECTIFS DE CHERCHEURS
DE L'ENSEIGNEMENT UNIVERSITAIRE

Facultés	1960	1966
Sciences (et grands établissements scientifiques)	4 000	9 500
Médecine et Pharmacie	2 900	7 400
Droit et Lettres	1 900	5 100
C.N.R.S.	3 350	5 300
Total	12 150	27 300

(1) Exigeant huit heures hebdomadaires de cours par groupe de 150 étudiants plus quatre heures de direction de recherche par groupe de 30.

III. PLACE RELATIVE DES FILIERES DE RECHERCHE ET DES AUTRES FILIERES D'ETUDES DANS L'ENSEIGNEMENT SUPERIEUR DE 3ème CYCLE

On a vu (I ci-dessus) combien la distinction entre les cours de préparation à la recherche et les autres types d'études de 3ème cycle était variable selon les facultés et finalement quelque peu arbitraire.

Dans les facultés de Sciences et de Lettres on peut distinguer toutefois :

- (i) une filière de recherche qui, depuis la maîtrise (ou la licence avant 1966), est suivie par les étudiants préparant le doctorat de spécialité et au-delà, pour une minorité au doctorat d'Etat (1) ;
- (ii) une filière à vocation plus générale suivie le plus souvent en vue de l'exercice de la profession enseignante (de l'enseignement secondaire). Celle-ci consistait, avant la réforme de 1966, en la préparation du diplôme d'études supérieures (D.E.S.) (équivalent au "master's degree" des pays de langue anglaise).

Le D.E.S. était exigé des candidats à l'agrégation et facilitait l'acquisition du certificat d'aptitude pédagogique à l'enseignement secondaire (C.A.P.E.S) (2).

Cette distinction un peu formelle n'est plus valable depuis la réforme de 1966 à la suite de la suppression des D.E.S.

Dans les autres facultés (Droit, Médecine), la situation est tout aussi difficile à caractériser, du fait de la mise en place très récente de filières originales de recherche. On peut considérer que les études postérieures au premier diplôme y visaient essentiellement l'acquisition d'une spécialisation (notamment en Médecine et en Pharmacie).

IV. LES DOCTORATS DE RECHERCHE

(a) Les doctorats de spécialité

Ils constituent certainement la filière la plus originale de l'enseignement de 3ème cycle et ils ont permis de pourvoir depuis 1960 la recherche scientifique en cadres qualifiés. Leur objet était "de donner aux étudiants des connaissances approfondies dans une spécialité et de les former aux manèges des méthodes de recherche".

- (1) En Sciences pures, il est fréquent que les étudiants préparent directement ce dernier doctorat, le plus souvent en approfondissant une recherche commencée dans le cadre de la préparation du doctorat de spécialité.
- (2) On ne retiendra pas ces deux types de préparation de concours de recrutement d'enseignants, bien que celle-ci soit assurée en partie par l'Université. Les statistiques des étudiants inscrits n'ont donc pas été incluses dans les effectifs de 3ème cycle. Sur le système de recrutement des professeurs de l'enseignement secondaire, on se reportera à : Formation, recrutement et utilisation des enseignants dans l'enseignement primaire et secondaire, ch. III, OCDE, 1972.

La durée des études est fixée au minimum à deux années :

- (i) Au cours de la première année, l'étudiant est amené à participer aux activités d'un groupe de travail placé sous le contrôle d'un directeur de recherche sous forme de séminaires et, dans les disciplines scientifiques, de travaux réalisés dans les laboratoires de recherche de la faculté (ou dans quelques cas extérieurs à celle-ci). A l'issue de cette première année, l'étudiant devait, pour s'inscrire en deuxième année :
- soit soumettre un rapport sur le travail accompli ;
 - soit faire preuve, dans une interrogation orale et des exercices pratiques, d'une initiation suffisante aux techniques de recherche propres à la spécialité choisie.
- (ii) La deuxième année (et éventuellement une troisième année) est consacrée à la préparation et à la soutenance d'une thèse, sous la direction du directeur de recherche.

Ce schéma général d'organisation des études, valable pour toutes les facultés concernées, a été ultérieurement modifié en 1964 dans les facultés des Sciences dans le sens d'un renforcement important de la formation reçue au cours de la première année et du contrôle des connaissances acquises, sous la forme d'un diplôme d'études approfondies (D.E.A.).

En effet, à la suite des premières années de fonctionnement, il est apparu que le niveau de connaissances de l'étudiant entreprenant une recherche personnelle - dans un domaine spécialisé - ainsi que la maîtrise des méthodes de recherche correspondantes étaient insuffisants. La réorganisation de l'enseignement de la première année visait donc à la fois à un approfondissement des connaissances dans la spécialité choisie et à un renforcement des enseignements d'initiation à la recherche (1). Elle a permis (bien qu'elle puisse être considérée aussi

(1) Selon ces nouvelles dispositions, le D.E.A. demande une année de préparation (après la maîtrise) assurée par un enseignement magistral (quatre heures hebdomadaires) et par un stage en laboratoire, ou en institut de recherche. Le diplôme est délivré aux candidats ayant subi avec succès les épreuves écrites et orales et la discussion d'un rapport sur leur stage. Le doctorat de spécialité est entrepris après le D.E.A. et est obtenu après la soutenance d'une thèse dans l'une des cinq disciplines suivantes : mathématiques, physique, chimie, sciences biologiques et sciences de la terre. D'autre part, a été créée l'attestation d'études approfondies (A.E.A.) délivrée à l'issue de la 1ère année aux candidats qui ne justifiaient pas de tous les titres requis pour le D.E.A. sont dispensés du stage et satisfont aux seules épreuves écrites et orales. Cette année d'études permet d'aménager une sortie des étudiants engagés dans le doctorat.

comme un certain renforcement de la sélection des candidats à une carrière de chercheur) d'améliorer considérablement la valeur scientifique des thèses produites et des diplômes conférés.

Ce renforcement de la formation des chercheurs a été accentué par la réforme de 1966 qui exige des étudiants entreprenant un doctorat de spécialité la possession de la maîtrise qui se proposait :

- d'amorcer une première spécialisation vers les activités de recherches au niveau de la préparation du premier diplôme ;
- d'accroître le niveau de culture scientifique de l'étudiant en repoussant officiellement d'une année les études de doctorat.

Evolution des effectifs inscrits aux doctorats de spécialités
(et des diplômes obtenus)

Le tableau XVII présente l'évolution des effectifs inscrits et des diplômés, il montre qu'au cours des cinq années 1962 à 1967 :

- (i) dans les facultés de Sciences : les effectifs inscrits sont passés de 3.500 à 12.000, cet accroissement rapide (240 %) est en partie dû à la création de l'A.E.A. En excluant cette catégorie, les effectifs augmentaient cependant de 3.500 à 9.200 (soit 160 % en 5 ans). Pendant cette même période, le nombre de diplômés (doctorats) avait doublé. Les taux de transfert des licenciés vers cette filière seraient passés de 50 % à 60 % environ.
- (ii) Dans les facultés de Lettres, l'évolution était encore plus rapide (triplément des effectifs et des diplômés), mais sur la base de chiffres plus faibles, et correspondant à des taux de transfert des licenciés beaucoup plus bas (10 % environ vers 1966).
- (iii) Les statistiques font apparaître que la durée réelle des études est beaucoup plus longue que la durée théorique et est de l'ordre de trois ans à trois ans et demi au lieu de deux.
Les rapports du nombre de diplômés aux effectifs de deuxième année étaient en 1966-67 de 38 % en Sciences et de 27 % en Lettres. En Sciences, ce rapport a enregistré un accroissement régulier depuis 1964 : la création du D.E.A., en accentuant la sélection des candidats au doctorat, semble donc avoir sensiblement amélioré le rendement des doctorats "scientifiques" (ou réduit la durée moyenne de préparation de la thèse). Entre 1964 et 1967, sur l'hypothèse d'une durée moyenne des études de trois années, les rapports entre les diplômés et les inscrits en première année étaient respectivement de 47 % en Sciences et de 57 % en Lettres, soit un rendement relativement faible de ces études.
- (iv) Dans les deux facultés, il semble que la majorité de ces abandons se produise à la fin de la première année. La création du D.E.A. et de l'A.E.A. en Sciences permet à cet effet de sanctionner une sortie vers la vie active (tableau XVIII)

TABIEAU XVII
DOCTORATS DE SPECIALITE
DOCTORATS D'ETAT

(inscrits et diplômés)

	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68
<u>I. Doctorat de spécialité</u>								
<u>Sciences</u>								
A.E.A.	-	-	-	-	-	-	1984	2294
1ère année	-	-	-	1987	2415	3435	4037	5621
2ème année	-	-	-	2175	2195	2618	2967	3549
Total AEA inclus	-	-	-	-	-	-	8988	11464
Total AEA exclu	1587	-	3528	4162	4610	6053	7004	9170
Diplômés	358	508	587	703	764	999	1127	1198
<u>Lettres</u>								
1ère année	-	-	444	465	665	943	1350	1874
2ème année	-	-	301	391	618	861	1390	1768
Total	381	-	742	856	1283	1804	2740	3650
Diplômés	64	101	118	173	225	247	376	...
<u>II. Doctorats d'Etat</u>								
<u>Sciences</u>								
Inscrits	1500	-	2452	2268	3666	525	5342	6276
Diplômés	237	339	342	425	547	339	825	816
<u>Lettres</u>								
Inscrits	373	-	349	354	414	331	396	291
Diplômés	42	57	65	65	75	81	75	11
<u>Droit</u>								
Inscrits	679	507	435	459	-	532	397	526
Diplômés	244	305	265	311	287	302	335	358

TABLEAU XVIII
EVOLUTION (APPROXIMATIVE) D'UNE PROMOTION
D'ETUDIANTS INSCRITS AU DOCTORAT DE SPECIALITE

	1966 - 1967			1969
	Inscrits (1ère année) (1)	Diplômés (2)		Doctorats (3) (en % des D.E.A.)
		%	% du total	
D.E.A.	4 037	3 002 (74)	(50)	1 500 (50)
A.E.A.	1 984	1 583 (80)	(25)	
Total	6 021			

Ces quelques chiffres font bien apparaître la diversification introduite dans cette filière d'études ; le doctorat de spécialité proprement dit n'est obtenu que par une minorité (un quart environ de ceux qui avaient entrepris ces études).

En effet, en moyenne, sur 100 étudiants qui entreprennent ces études, 25 obtiendront une A.E.A., 50 un D.E.A., la moitié de ces derniers obtenant ultérieurement un doctorat. Aucune information ne permet de connaître l'utilisation professionnelle à chacun de ces trois niveaux de sortie. Il est cependant certain que si les titulaires du doctorat accèdent en majorité à des postes de chercheurs ou entrent dans la carrière universitaire, les titulaires du D.E.A. et de l'A.E.A. semblent s'orienter à la fois vers la recherche (du secteur privé notamment) et vers des activités plus spécialisées ; à cet effet, de nombreuses universités ont créé, ou projettent de créer, des D.E.A. professionnels ; le stage n'ayant plus lieu seulement dans des laboratoires de recherche, mais étant directement en relation avec la production.

(b) Les doctorats "traditionnels"

On rappellera que ces doctorats sont en Sciences et en Lettres de deux natures : (voir section I)

- doctorats d'université (préparés essentiellement par les étudiants étrangers)
- doctorats d'Etat.

Seule cette dernière catégorie de doctorats sera examinée.

Leur préparation constitue une contribution très approfondie à la recherche et à l'évolution des connaissances. Le diplôme permet d'accéder aux postes d'enseignement de niveau supérieur dans les universités et d'encadrement des équipes de recherche. Jusqu'en 1968, la préparation de ce doctorat consistait uniquement en la rédaction d'une thèse qui pouvait exiger en Lettres notamment jusqu'à dix années. Depuis cette date, le titre peut être acquis sur présentation et soutenance de divers travaux scientifiques ce qui permettra certainement d'associer plus étroitement sa préparation aux activités de recherche.

Au tableau XVII est mentionnée l'évolution des effectifs inscrits et diplômés qui montre que : a) seules les facultés de Sciences produisent un nombre important (825 en 1967) et croissant (150 % au cours de la période 1962-1967) de doctorats d'Etat. Ces doctorats se répartissaient selon les disciplines de la façon suivante :

	Pourcentages	
	1964	1967
Sciences mathématiques	7.0	7.3
Sciences physiques	68.0	62.4
Sciences naturelles	22.6	24.4
Sciences appliquées	2.4	2.5
	100.0 (425)	100.0 (825)

L'extension des besoins de l'enseignement supérieur et de la recherche a certainement permis d'absorber la quasi-totalité de ces diplômés de haut niveau, qui occupent aussi parfois des postes de direction dans l'industrie. Mais aucune information précise n'est disponible quant à leur utilisation.

En Lettres et en Droit, par contre, le nombre de doctorats d'Etat décernés est plus réduit (75 et 350 en 1967) et n'a pas augmenté depuis 1960. En Lettres, ces doctorats permettent essentiellement d'assurer le recrutement des professeurs universitaires titulaires, dont les effectifs (et donc les besoins) sont très réduits (400 en 1968). En Droit, la diminution semble s'expliquer par la revalorisation de l'enseignement de licence (la faiblesse de la formation antérieure exigeant la prolongation des études jusqu'au doctorat).

Aucune information ne permet de connaître la durée moyenne de ces études (qui sont d'ailleurs différentes selon les facultés) ni sur leur rendement. Les rapports inscrits/diplômés qui étaient en 1966-67 de 6,5 en Sciences, de 5,5 en Lettres, de 1,2 en Droit ne peuvent apporter qu'une indication très approximative sur ce point.

(c) Contribution des études de doctorat à l'effort de recherche des universités

Aucune information statistique précise n'est disponible sur ce point.

La Commission de la recherche scientifique du Vème Plan (1966-1970) qui a évalué par secteur d'exécution les effectifs de chercheurs, précise que "les étudiants préparant des diplômes d'études supérieures ou des doctorats de 3ème cycle ne sont pas comptés, sauf s'ils figurent dans une des catégories précises (assistants de faculté, stagiaires du C.N.R.S.)". Mais la proportion de ces derniers n'est pas connue ; de plus, au cours des dernières années, sous l'effet de l'accroissement de l'offre de chercheurs, le niveau de recrutement de ces catégories a nettement augmenté : dans certaines disciplines en 1970 il faut être titulaire d'un doctorat de spécialité (ou d'un excellent D.E.A) pour devenir assistant ou stagiaire de recherche alors que vers 1963-1965 la possession d'une licence suffisait.

La Commission de l'équipement scolaire et universitaire proposait, d'autre part, (page 131 de son rapport) que "sur cinq étudiants de doctorat de spécialité (des facultés de Sciences) trois puissent être pris en charge par l'enseignement supérieur en qualité d'assistants, et les deux autres par le C.N.R.S. en qualité d'attachés ou de stagiaires de recherches, ou encore par d'autres organismes publics ou privés de recherche". Ces propositions justifiées par des considérations financières ne semblent pas avoir été entièrement retenues et ne sont donc pas utilisables en vue d'une évaluation de la contribution des études de doctorat à la recherche.

V. LES AUTRES COURS DE 3ème CYCLE (Autres que les doctorats de recherche)

1. Le diplôme d'études supérieures (D.E.S.) qui pouvait être comparé au "master's degree" bien qu'il n'ait pas comme ce dernier une vocation professionnelle mais seulement académique, sera retenu et préparé dans les facultés de Sciences, de Lettres (jusqu'en 1966) et de Droit (voir section I ci-dessus).

En fait, ce diplôme permettait d'acquérir une formation complémentaire aux études de licence et une spécialisation à l'intérieur de la discipline dans laquelle avait été obtenu le premier diplôme. De plus, à un enseignement académique s'ajoutait la préparation d'un mémoire qui, en Sciences pures et dans certaines disciplines des Sciences humaines, pouvait avoir la valeur d'un travail de recherche. L'année de ce D.E.S. pouvait donc être considérée comme une année intermédiaire entre les enseignements des premiers cycles et la préparation du concours d'agrégation (en Sciences et en Lettres) ou du doctorat (en Droit).

La valeur académique du D.E.S. semble avoir été assez liée à celle du premier diplôme (licence) et pouvait souvent constituer une année universitaire terminale. Sa suppression et la création de la maîtrise (en Sciences et en Lettres) a donc consisté à intégrer cette formation dans le cycle d'études préparant au premier diplôme et à revaloriser ce dernier (bien qu'officiellement la maîtrise voulait être spécifiquement un cycle de pré-orientation à la recherche).

L'évolution des effectifs inscrits des diplômés montre : (tableau XIX)

- (i) Qu'en Sciences, les effectifs (et les diplômes) ont cessé de croître à partir de 1963-64. A cette date (si l'on exclut les redoublants), environ 43 % des licenciés entreprenaient la préparation d'un D.E.S. (contre 30 % qui s'orientaient vers le doctorat de spécialité). En 1966-67, c'était le cas de moins de 30 % (alors que 60 % environ commençaient un doctorat). Il est donc évident que l'orientation vers le doctorat de spécialité s'est faite aux dépens de la préparation du D.E.S. et qu'au cours des années qui ont précédé sa suppression, il n'était entrepris que par les étudiants qui se destinaient au professorat de l'enseignement secondaire.
- (ii) En Lettres, où environ 80 % des licenciés se destinaient au professorat (1966), les effectifs inscrits au D.E.S. se sont accrus jusqu'en 1966 (100 % entre 1961 et 1966), et les rapports inscrits/licenciés de l'année précédente sont restés constants (80 %).
- (iii) Les répartitions des D.E.S. délivrés par chacune de ces facultés par branches d'études n'ont pas varié au cours de la période considérée (1960-1966) dans aucune des facultés et étaient les suivantes (en 1965-1966) :

	Pourcentages	Effectifs
<u>Sciences</u>		
Mathématiques	12.0	
Physique et chimie	63.0	
Sciences naturelles	35.0	
	<u>100.0</u>	1 150
<u>Lettres</u>		
Philosophie	14.2	
Lettres classiques	22.5	
Histoire	18.5	
Géographie	16.8	
Lettres modernes	26.6	
	<u>100.0</u>	2 285

Dans les deux cas, les durées des études étaient de l'ordre d'une année et demie contre une année prévue.

- (iv) En Droit et en Sciences économiques, les effectifs inscrits et diplômés (1) ont augmenté (40 % entre 1962 et 1967) plus lentement que le nombre de premiers diplômés (75 % entre 1961 et 1966). Dans le cas de cette faculté, où les doctorats

(1) Les taux de réussite aux examens en vue des D.E.S. étaient de 50 % en 1966.

TABLEAU XIX

COURS DE 3^{ème} CYCLE (AUTRES QUE LES DOCTORATS)

EFFECTIFS ET DIPLOMES

	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68
<u>I. Diplômes d'études supérieures</u>								
<u>Sciences</u>								
- inscrits	1705	-	2114	1897	2171	2397	2017	1382
- diplômés	1243	1272	1353	1125	1225	1147	1195	664
<u>Lettres</u>								
- inscrits	3185	-	4198	5179	5466	5655	8141	-
- diplômés	1738	1897	1979	2348	2756	3282	5252	-
<u>Droit</u>								
- inscrits	3681	3750	3936	4547	-	5038	5309	5393
- diplômés	818	896	728	887	1023	1164	1310	-
<u>II. Spécialisations médicales</u>								
- inscrits	6171	6548	7665	8643	8443	9884	8742	9112
- diplômés	1614	1625	1767	1772	1641	1978	3871	-

de spécialité sont récents et préparés en nombre négligeable, il semble donc que l'on enregistre une diminution des taux de transfert vers les études de 3ème cycle, qui pourrait s'expliquer par la revalorisation des premiers diplômes (licences en Droit) et la création de la licence ès sciences (Sciences économiques) à la suite de la réforme de 1959.

2. Les spécialisations médicales

Au-delà des doctorats en médecine et du diplôme en pharmacie (qui constituent des premiers diplômes universitaires), les seules études post-graduées (1) dans ces branches d'études consistaient en la préparation de certificats d'études spéciales (C.E.S) qui permettaient d'acquérir une spécialisation médicale (et un titre de spécialiste). La durée des études variait de une à quatre années suivant les trente spécialités offertes, un seul étudiant pouvant en préparer simultanément plusieurs.

Si l'on exclut ces doubles comptes, on peut évaluer en 1966 à environ 70 % la proportion de docteurs en médecine qui entreprenaient une spécialisation. Au cours de la période 1960-1966, les effectifs inscrits aux C.E.S. se sont accrus (60 %) tandis que le nombre annuel de diplômes de docteurs en médecine restait constant.

Le nombre de diplômes de spécialités délivrés correspondait à une proportion constante (60 %) de diplômes présentés, proportion qui est restée constante au cours de la période retenue.

VI. UTILISATION DES DIPLOMÉS DES ETUDES DE 3ème CYCLE

Il n'existe en France à notre connaissance aucune information statistique (ni aucune enquête en cours) sur l'affectation des diplômés de 3ème cycle par secteur ou branche d'activité économique. En particulier, comme cela a été déjà mentionné, on ne connaît pas actuellement quelle est l'orientation professionnelle des titulaires des doctorats de spécialités et dans quelles proportions ces derniers sont affectés aux activités de recherche, d'enseignement ou autres. Ces lacunes statistiques s'expliquent certainement par le fait que dans leurs travaux, les Commissions de planification (du Vème Plan) ne se sont pas préoccupées (après avoir quantifié les besoins en chercheurs ou en enseignants du supérieur) de déterminer exactement la nature de l'offre de personnel à recruter, notamment en ce qui concerne les titulaires des doctorats de spécialité :

(1) L'introduction de filières de recherches est trop récente pour être évoquée (page 159 V.1).

1. Le rapport de la Commission de la recherche scientifique et technique du Vème Plan (vol. 1, page 303) a évalué les besoins en chercheurs de chaque secteur d'exécution de la recherche. Cependant, les ressources prises en considération sont :

- les titulaires des premiers diplômes (licences et diplômes d'ingénieurs) (1) pour l'ensemble des chercheurs (de toute formation) ;
- les titulaires des seuls doctorats d'Etat pour l'encadrement des chercheurs de formation scientifique. En 1965, 25 % de ces chercheurs étaient titulaires d'un doctorat d'Etat. Pour obtenir un taux d'encadrement d'un tiers (docteurs d'Etat /non docteurs), il faudrait que la recherche absorbe entre 1966 et 1970 tous les docteurs d'Etat formés (soit 3.500) et ne compte aucun départ du stock initial (3.200 sur 13.000 chercheurs).

2. La Commission de l'équipement scolaire et universitaire a dû évaluer les besoins en enseignants de l'enseignement supérieur, compte tenu de certaines normes d'encadrement (4ème partie, chapitre V de son rapport). Ainsi en Sciences :

- (i) les maîtres-assistants et assistants seraient recrutés parmi les étudiants de 3ème cycle, et il est précisé simplement que "le nombre de ces étudiants devrait être suffisant pour permettre de pourvoir les postes correspondants" (page 133).
- (ii) les professeurs et maîtres de conférences recrutés parmi les docteurs d'Etat absorberaient 30 % du nombre de ces titres délivrés entre 1966 et 1972.

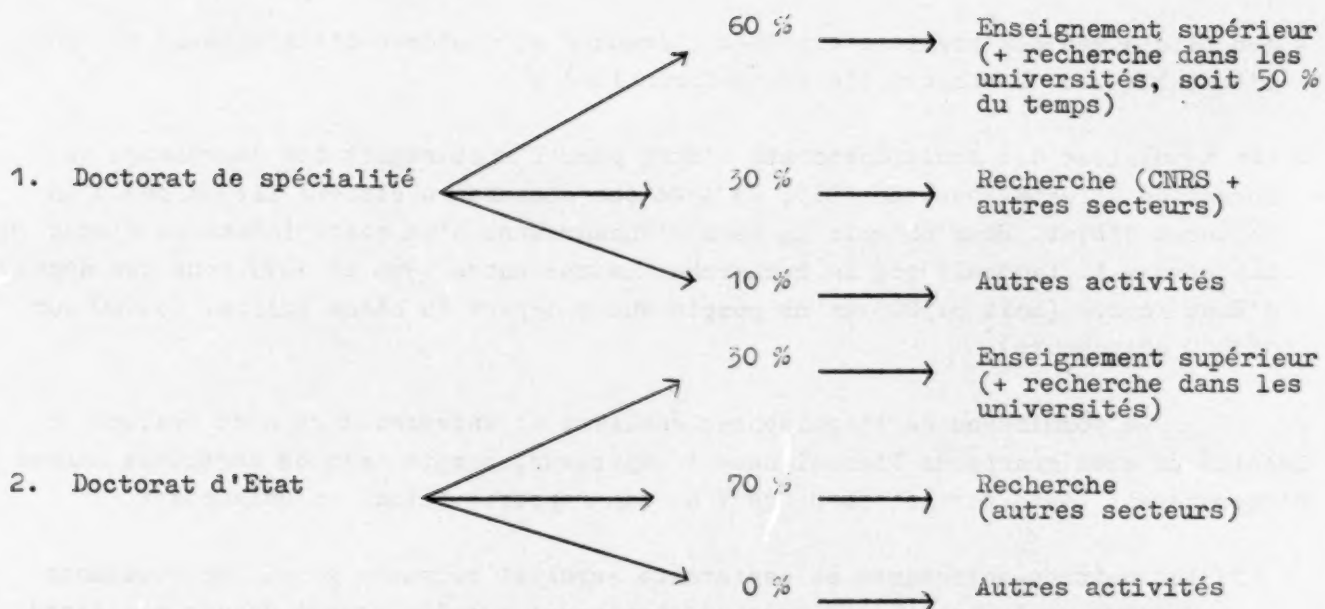
En Lettres et Sciences humaines

- (i) les assistants et maîtres-assistants seraient recrutés parmi les agrégés ;
- (ii) la totalité des docteurs d'Etat devrait être recrutée pour couvrir les besoins en professeurs et maîtres de conférences.

Sur la base de ces informations partielles, on pourrait évaluer - de manière très grossière - les principaux flux de passage de certaines filières (conduisant aux doctorats) vers la vie active pour la période 1966-1970 :

(1) On estimait qu'en 1962-63, la recherche et l'enseignement supérieur absorbaient 35 % des flux de sortie des premiers diplômés, et devraient en absorber 42 % pour couvrir les besoins au cours de la période 1966-1970.

Sciences



VII. PROBLEMES ACTUELS ET POLITIQUES DE REFORMES

Les problèmes spécifiques de l'enseignement de 3ème cycle ont rarement été posés au cours de ces dernières années lors du débat permanent sur la réforme des universités. En effet, depuis 1968, au cours de la lente et difficile application de la loi d'orientation, le débat a porté essentiellement sur les problèmes de la réorganisation administrative et sur la mise en pratique des principes de cette loi (participation, autonomie, pluridisciplinarité). Au cours des deux années antérieures (1966-1968) c'était la réforme des premiers cycles d'études dans les facultés des Sciences et des Lettres et les vives critiques qu'elle avait occasionnées qui avaient été au centre du débat (1).

On peut considérer que les structures des études de 3ème cycle ont rarement été abordées directement, mais essentiellement à partir des discussions engagées depuis quinze ans sur le problème de la réorganisation de la recherche fondamentale dans les universités. Les points essentiels sur lesquels ont porté ce débat (2) étaient :

(1) Etudes de cas sur l'Innovation dans l'enseignement supérieur - Expériences françaises avant 1968 - OCDE (Paris 1970).

(2) Le colloque de Caen (1966) avait abordé tous ces thèmes et constitué le "sommet" du débat.

- la suppression du cloisonnement entre les facultés et la création de départements ;
- l'association d'instituts de recherche aux unités d'enseignement et leur utilisation en matière de formation des chercheurs ;
- le recrutement des enseignants en fonction de la valeur scientifique, et non plus sur titre ;
- la possibilité de faire appel à des sources de financement plus variées, d'établir directement des contrats de recherche, de multiplier les relations avec l'industrie, etc.

Certaines de ces propositions ont été retenues par les réformes les plus récentes, mais il est encore impossible de préjuger de leur succès. C'est notamment le cas des réformes en vue de la réorganisation de la recherche médicale, dans le cadre des C.H.U., et surtout des possibilités offertes par la loi d'orientation de 1968.

Celle-ci n'a pas affecté la structure des études mais a défini en priorité le cadre administratif ; cependant certaines modalités ne manqueront pas d'avoir des répercussions directes sur les études de 3ème cycle :

- (i) L'université seule décidera de l'affectation des crédits de recherche et aura la possibilité de signer des contrats de recherche avec des organismes extérieurs, sans avoir à obtenir l'approbation du ministère.
- (ii) "Les titres de docteurs sont conférés après la soutenance d'une thèse ou la présentation en soutenance d'un ensemble de travaux scientifiques originaux. Cette thèse et ces travaux peuvent être originaux, ou, si la discipline le justifie, collectifs, déjà publiés ou inédits" (article 20).
- (iii) L'université qui doit contribuer à adapter à tous les niveaux d'enseignement le contenu des enseignements et les débouchés professionnels, pourra créer elle-même des sections de recherche, modifier le contenu des formations, délivrer ses propres diplômes, etc.

On peut donc supposer que cette réforme va contribuer à modifier l'organisation des études de 3ème cycle. En effet :

- (i) La loi d'orientation va favoriser une spécialisation des universités dans certains domaines de la recherche (et de la formation des catégories de chercheurs correspondants) et créer ainsi des "centres d'excellence" (bien que le ministère de l'Education nationale ne semble pas vouloir encourager directement cette "concentration", souhaitée par les planificateurs).

- (ii) Il faut s'attendre à une amélioration et à une diversification des recherches qui seront présentées pour requérir le titre de docteur, ainsi qu'un développement des équipes de recherche.
- (iii) Il est probable que l'autonomie pédagogique sera utilisée pour conférer aux diplômés (D.E.A., doctorat de 3ème cycle) une valeur professionnelle, et non plus seulement académique. Certaines initiatives tendent déjà à créer des "D.E.A. scientifiques spécialisés" (à côté des D.E.A. préparatoires à la recherche) directement utilisables dans l'industrie. Elles contribueraient à diversifier la formation dispensée aujourd'hui au cours du doctorat de spécialité qui reste essentiellement orientée vers la préparation à la recherche.
- (iv) Enfin, si les universités utilisent les possibilités de faire appel à des ressources financières nouvelles (contrats de recherche), il est probable que l'augmentation des moyens va contribuer à une extension de leurs activités.

A l'inverse, on doit signaler qu'une fraction importante du corps enseignant semble douter des possibilités réelles offertes par cette loi, dans les domaines de la préparation et de l'exercice de la recherche fondamentale à l'intérieur des universités.

Des critiques font apparaître que le cloisonnement qui tend à se créer entre les départements ou les difficultés que rencontre le fonctionnement de l'autonomie (notamment l'autonomie financière) ne vont pas modifier beaucoup la situation passée de la recherche universitaire. Certains même pensent que sa réorganisation ne saurait aboutir qu'en dehors des unités d'enseignement, dans des instituts intégrés aux universités mais autonomes.

Il ne semble pas dans l'immédiat qu'une réforme de la structure de ces études soit envisagée, ce qui (en Sciences et en Lettres) aurait pu achever la réforme entreprise en 1966 dans les premiers cycles. Le fonctionnement actuel est toutefois très inégalement satisfaisant selon les facultés. Les raisons en sont doubles :

- (i) Le système traditionnel (D.E.S., agrégation, doctorat d'Etat) n'a pas été - sauf le D.E.S. - modifié sous l'effet de pressions conservatrices émanant surtout du corps professoral (Société des Agrégés, professeurs titulaires de chaires).
- (ii) Les nouvelles filières ont été ajoutées au système ancien, et plus ou moins bien intégrées ; de ce fait, le caractère innovateur a été souvent retraduit dans la logique du système ancien. L'exemple le plus frappant (1) est celui de la maîtrise qui devait amorcer une préorientation vers les doctorats de spécialité et initier les étudiants aux techniques de la recherche. En réalité elle a tendu à se substituer à l'ancien D.E.S. et - en Lettres notamment - se confond souvent avec la préparation d'un mémoire.

(1) Innovation dans l'enseignement supérieur - Expériences françaises avant 1968, OCDE (Paris 1970).

Un autre aspect de cette politique d'"additions" successives a consisté à étendre à certaines facultés les filières mises en place dans d'autres : dans les facultés des Sciences, le doctorat de spécialité a eu des résultats remarquables, essentiellement parce que sa structure et sa finalité ont pu être établies avec une grande souplesse. Par contre, sa transposition aux facultés de Lettres et de Droit a été en partie un échec, et ceci pour plusieurs raisons :

- l'organisation des études y a toujours été beaucoup plus rigide ;
- les conditions matérielles n'étaient souvent pas réunies pour la pratique de la recherche ;
- le conservatisme universitaire n'a pas permis aux docteurs de 3ème cycle d'accéder aux postes d'assistants réservés aux titulaires de l'agrégation ;
- l'enseignement de première année est resté souvent superficiel et soumis à un contrôle peu rigoureux, qui conduisait à la présentation de thèses de faible valeur scientifique ; il est probable que le D.E.A., qui avait été créé en Sciences pour pallier ces insuffisances, soit étendu aux études de Lettres, ce qui semblerait très souhaitable [et a d'ailleurs été fait dans quelques disciplines (psychologie, etc.)].

L'un des changements structurels importants qui semble devoir affecter à court terme les études de 3ème cycle est la diversification. Il semble en effet urgent de créer, à côté des doctorats de formation à la recherche, des doctorats de formation à la profession dans des domaines spécialisés (et qui varieraient suivant les universités et les besoins régionaux ou nationaux).

La création de D.E.A. spécialisés pourrait être la première étape de ce processus. Cette diversification du 3ème cycle semble correspondre à la fois :

- à la nécessité d'associer plus étroitement l'université aux activités des secteurs de l'économie ;
- à la nécessité d'adapter les formations universitaires aux débouchés professionnels et aux besoins en personnel hautement qualifié ;
- à l'évolution des structures universitaires ; la dévalorisation des premiers diplômes encourage les étudiants à poursuivre leurs études et à accroître ainsi le bénéfice social de leurs études ; à cette tendance doit correspondre une diversification (1) des types de formation au niveau du 3ème cycle, et une extension de ses fonctions actuelles de préparation à l'enseignement et à la recherche.

(1) Une autre réponse à cette évolution est le renforcement des mesures de sélection et de contrôle au niveau de la première année du 3ème cycle, ainsi que la restriction d'attributions d'aides financières aux étudiants (ce qui s'est produit depuis 1969).

ANNEXE

INFORMATIONS COMPLEMENTAIRES SUR LA FORMATION DES CHERCHEURS (1964-65)

1. Formation scientifique des chercheurs selon les disciplines (1964)

(Pourcentages)

Formation (1er dipl)	Maths.	Physique	Chimie	Sciences de la terre	Biologie	Total	(effectifs)
a. Facultés	35.5	43.4	48.0	54.6	70.8	53	(5903)
b. Grandes Ecoles (et écoles d'ingé- nieurs) (1)	53.4	51.3	49.8	41.3	25.5	43	(4758)
c. Autres	13.1	5.3	2.2	4.1	3.7	4	(434)
Effectifs	(920)	(3430)	(2728)	(772)	(3245)		(11095)

(1) Ces derniers se consacrent en général à la recherche appliquée dans le secteur de l'Etat mais surtout dans le secteur privé.

2. Formation scientifique de base des chercheurs du secteur de l'enseignement (1965)

(Pourcentages)

Formation	Enseignement supérieur	C. N. R. S.
a. Facultés	68.0	62.0
b. Grandes Ecoles (et écoles d'ingénieurs)	30.0	33.0
c. Autres	2.0	5.0
	100.0	100.0

3. Formation scientifique (du niveau du 3ème cycle) des chercheurs (1964-65)

Effectifs : 11.095.	Sont titulaires d'une agrégation	10.9 %
" "	d'un doctorat de	
" "	spécialité	6.4 (1)
" "	d'un doctorat	
	d'Etat	27.0

(1) On doit se rappeler que ce diplôme est de création récente (1954). Cette proportion a sans doute augmenté beaucoup depuis 1964-65. Entre 1954 et 1963-64, 2.150 doctorats de spécialité avaient été décernés ; en 1964-65, 600 d'entre-eux étaient chercheurs, mais ces chiffres ne sauraient mesurer un "taux de passage" pour plusieurs raisons (poursuite des études, service militaire, etc.).

ANNEX C

POSTGRADUATE EDUCATION
IN THE FEDERAL REPUBLIC OF GERMANY

TABLE OF CONTENTS

	<u>Page</u>
I. <u>THE DEGREE SYSTEM IN GERMANY</u>	171
(a) The Traditional Examinations.....	171
(b) The Situation Today.....	171
II. <u>SOURCES OF FINANCIAL SUPPORT</u>	173
(a) The "Honnet Scheme".....	174
(b) "Kategorialförderung".....	174
(c) Schemes for Talented Students.....	174
(d) University and Research Council Funds.....	174
(e) Other Funds.....	175
(f) The Present Situation.....	175
(g) The Future Situation, and Government Policy.....	177
III. <u>THE NATURE OF THE DOCTORATE</u>	178
IV. <u>CURRENT PROBLEMS, AND POLICIES FOR REFORM</u>	185
(a) The Reform of Academic Studies.....	185
(b) The Finance of University Studies.....	186
(c) Increasing University Specialisation.....	186
SOURCES OF TABLES.....	188
BIBLIOGRAPHY.....	189

Due to the paucity of information, it has been necessary to depart to some extent from the model established in other studies. Both the traditional attitude to the doctorate in Germany, as well as the autonomy of, and difference between, Länder in educational matters, contribute to an unfortunate lack of information on postgraduate study. There is evidence, however, that the situation is changing.

I. THE DEGREE SYSTEM IN GERMANY

In Germany, as in those European countries which to a large extent adopted the German higher education model, the delineation of any area of postgraduate studies is beset by difficulties. The traditional degree and examination structure still exists to a considerable extent, and it is necessary to describe it if any real comparison with other academic traditions is to be possible.

(a) The Traditional Examinations (1)

Traditionally, there are two types of examination which can conclude university study: these may be designated "academic" and "state" examinations. The academic examinations - traditionally leading to the doctorate in the old faculties - have not since the 18th century been regarded as in any sense qualifying for admittance to a profession. They are intended "to test the student's ability to do scientific work..... The principal part of the examination is therefore a scientific treatise, the dissertation..... [which] is printed as an initial specimen of scientific work, that is to say, is submitted to the judgement of the scientific world, while other examination tasks have fulfilled their purpose when they assist the examiner to pass judgement upon the candidate." Even at the very beginning of the present century, when Paulsen was writing, the thesis requirements of different faculties differed greatly. In the medical faculty, where licence to practice depended upon the passing of the state examination, the dissertation had become a formality allowing the bestowal of the traditional doctorate. It remains true that in medicine the dissertation is, generally, of little scientific merit. The state examinations derive from ecclesiastical examinations for the clergy, spreading subsequently into other faculties and in particular into state-controlled professions. For example, a state medical examination was introduced in Prussia in 1725, and an examination for candidate gymnasium teachers in 1810. They confer the right to practice a profession.

(b) The Situation Today

The situation which exists today is one of partial reform, and this may be illustrated by an example. In the philosophical faculties, for example, we have described how the traditional termination point of higher education was the doctorate. The state examination was introduced for those who wished to be teachers. But what of those who do not? The duration of doctoral study in the philosophical faculty is long; very many fail to obtain the degree and are forced to leave the university without a qualification. This may be due simply to an inability to write a dissertation. In order that there should be a qualification accessible to such people who neither want to teach nor perhaps to take the doctorate, in the early 1960s a degree of M.A. was introduced as a first degree. However, the value of a degree is bound up with its social status; a new degree - of whatever level - can only affect the traditional pattern if its prestige is high, or if employers are prepared to pay its recipients well. This, of course, cannot be legislated for. The status of the M.A. has yet to be established and until then cannot be a real alternative to the doctorate.

(1) This section is based upon Friedrich Paulsen: The German Universities and University Study (English edition, London, 1906).

TABLE I
PERCENTAGES OF ALL DOCTORATES AWARDED (BY AREAS OF STUDY)
REQUIRING FIRST STATE OR DIPLOMA EXAMINATIONS
(1956-57 - 1964-65)

	1956-57	1960-61	1964-65
Pure science	66	81	86
Technology	100	100	100
Agriculture	100	100	100
All Science and Technology	79	88	92
Medicine	100	100	100
Humanities	11	5	4
Law	85	96	100
Social science	85	81	73

The status of the doctorate is of course very high in Germany. However, this degree is not a professional degree - that is, a preparation for a career. The status attaches to the title rather than to the learning of its holder. The scholarly content is probably increasing, however, and the growing tendency in many faculties for the doctorate to be a postgraduate degree (see Table I) must contribute to this. In the natural sciences the degree is generally acknowledged to be of somewhat lower intellectual standing than the Anglo-American Ph.D. In fact, German universities differ very considerably in the regulations for admittance to doctoral study and in the intellectual rigour with which dissertations are judged. Thus a doctorate in economics from University X may be outstanding, whereas one from University Y is poor. The situation may be reversed in physics.

On the whole, the lack of professionalisation, of formalisation, of supervision, means that discussion of postgraduate education in Germany is exceedingly difficult.

Since it has not hitherto been considered a major problem, the statistics which permit analysis are rather lacking. But the situation is changing and it is possible to say that the traditional German degree system has left behind two major problems, which are now recognised as such. The first is the problem of establishing the status of non-doctoral degrees - whether the M.A. in arts or the diploma in science. The second is the need to upgrade and professionalise the doctorate; as the doctorate becomes accepted as preparation for an academic career, so the need for Habilitation may disappear.

Table II presents estimates which have been made of the postgraduate enrolment in German universities. However, since the doctorate can still be a first degree, this is a somewhat academic parameter and may have little basis in reality. An equivalent percentage today would be between 2.5 and 3.0 per cent.

TABLE II
ESTIMATED POSTGRADUATE ENROLMENTS AS % OF TOTAL ENROLMENTS (1)
(PROMOTED STUDENTS AS % OF TOTAL)
1952- 1959

Year	All Students	Promoted Students	%
1952	112,120	8,047	7.2
1953	112,795	7,678	6.8
1954	117,347	7,248	6.2
1955	123,469	6,476	5.2
1956	135,759	6,312	4.7
1957	148,224	6,039	4.1
1958	164,519	5,825	3.5
1959	177,260	5,572	3.1

(1) G. Bengeser: Doktorpromotion in Deutschland (Bonn, 1964), quoted Gebhardt (loc. cit.), pp. 26-7.

II. SOURCES OF FINANCIAL SUPPORT

The finance of postgraduate study in the Federal Republic differs very considerably from its finance in the other countries considered in this report, with the partial exception of Norway. Because postgraduate studies have not been regarded as, and have not been, as distinct a part of higher education as they are in the United States, for example, their finance is not so clearly distinguishable. Many statistics on student finance do not distinguish the level of education, although they may distinguish students by their number of semesters of study. Much of what is termed "postgraduate" in this report is financed in exactly the same way as study for the diploma or state examination. Thus, the schemes described below will benefit principally the non-promoted students. Although in the last few years the particular financial needs of postgraduate students have received greater attention. This has been a consequence of estimates which have been made of the numbers of academic personnel needed to cope with expanding student numbers. We shall say something of current Federal policy towards postgraduate student support below.

A study by the Deutsches Studentwerk (1964) showed that about 50 per cent of all German students enrolled at universities financed their studies entirely through their parents, whilst another 20 per cent or so received some parental support (1). Approximately 30-35 per cent financed their studies wholly or in part from one of the public schemes described below. Thus, 16.9 per cent received assistance under the "Honnef Scheme", 10 per cent under the "Kategorialförderung", and 1.5 per cent under the scheme for the "exceptionally talented" students. Another 2 per cent received funds from various other public sources.

(1) This, and much of what follows, is taken from Higher Education in the Federal Republic of Germany (published in English by the German Academic Exchange Service, D.A.A.D., in May 1966), pp. 26-8.

(a) The Honnef Scheme

This scheme, introduced in 1957, is intended to provide financial aid to students from less affluent backgrounds. The cost is divided between the Bund and the Länder and is operated by the universities in accordance with a set of uniform regulations. All students admitted to Hochschulen are potentially eligible for help through their first three semesters of study. Continuation up to the final examination - which will usually be a diploma or state examination except in the philosophical faculty - is possible if intermediate examinations are passed. It seems unlikely that many properly postgraduate students in the natural or social sciences, who will almost all have previously passed a final examination before promotion, will be supported under this scheme.

(b) Kategorialförderung

This scheme is intended to compensate to some extent for the persecution of certain groups of the population by the Nazi regime. It is therefore restricted to certain classes of individuals. The whole scheme is temporary and when it is discontinued there may be a consequent increase in the numbers supported under the Honnef Scheme. As with the latter, it seems unlikely that many promoted students are financed in this way.

(c) Schemes for Talented Students

These schemes are operated principally by private foundations. Although in total numbers their efforts may appear modest, there is little doubt that they, in particular, contribute to the production and education of future members of the academic community. They are thus of particular relevance here. All these schemes include support for postgraduate students, and information on their recipients is available from recent studies. Foundation policy is of course to stimulate state support of certain areas rather than to take over the state role. The Volkswagen Foundation, for example, is increasingly concentrating its efforts in selected fields (especially inter-disciplinary fields) and on the support of students taking postgraduate conversion, or "second study", courses (Zweitstudien). Support schemes are operated by the following bodies:

Studienstiftung des Deutschen Volkes	(1,600 - 2,000 awards)
Cusanuswerk Stiftung (Catholic)	(250 - 300 awards)
Evangelisches Studienwerk Villigst (Protestant)	(400 - 450 awards)
Stiftung Mitbestimmung (Trade Union)	(270 - 300 awards)
Friedrich Ebert Stiftung (S.P.D.)	(300 - 350 awards)
Konrad Adenauer Stiftung (C.D.U.)	(relatively recent)
and indirectly by	
(Volkswagenwerk Stiftung) (1)	

On average, some 18 per cent of these are postgraduate students. The distribution by level of study and by discipline is discussed below.

(d) University and Research Council Funds

Additionally, a number of university assistants are working on their doctoral dissertation. They are paid university salaries from university funds. We have no information on the numbers of assistants preparing doctorates.

(1) The V.W. Foundation works indirectly by financing the programmes of the other foundations as well as by support channelled through the universities.

Germany is unique in that the Research Council (Deutsche Forschungsgemeinschaft, D.F.G.) has no statutory obligation to support postgraduate study. It thus has no fellowship scheme at this level, although it does at the postdoctoral level (in 1969 it awarded 490 Habilitation stipends, of which 88 were in the natural and applied sciences) (1). Of course, a number of research assistants supported from grants do work for their doctorate whilst engaged on their other research. In 1969, the regulation that students working for doctorates whilst employed on D.F.G. research projects were paid only half-salary was dropped. Thus, any research assistant who has a diploma is now paid a full salary (2). No data exist, however, on the number of students pursuing doctorates whilst financed from D.F.G. research funds.

(e) Other Funds

The two remaining sources of significant support in Germany are the Max-Planck-Institute, and private industry. Approximately 150-200 students per annum pursue their doctoral work within one of the research institutes of the M.P.G. There are no comparable figures for industry. In fact, a number of companies do support students, who are generally put under contract whilst carrying out their work. However, the total number is not large.

(f) The Present Situation

The number of postgraduate students supported directly from government funds is almost certainly a very small percentage of the total number of students supported from public funds. Furthermore, there has been no policy for the specific support of postgraduate students under schemes such as the Honnef, i.e. from educational funds. Some of the foundations have, however, had specific Promotionsstipendien programmes. The D.F.G. has no mandate to support research study, and although it is possible that a fairly large number of research assistants paid by them are working upon their dissertations, this is not the result of any deliberate policy. In other words, neither on the part of educational agencies nor on that of research agencies has there been any specific policy towards the encouragement of postgraduate study. This is in line with earlier educational thinking in the Federal Republic, which envisaged what is being called postgraduate in this report simply as one part of the whole educational process. Since it was not seen as training for a specific career (e.g. in research or in higher education) it was conceptually impossible - as well as contrary to the whole German approach to education - to make any estimates of need from which policies could flow.

In the following paragraphs, aspects of student support by the foundations are considered, not only because more information is available but also because it is to the foundations that we may look for a long-standing appreciation of the particular needs of future researchers and future academics.

(1) D.F.G.: Bericht 1969, p. 39.

(2) D.F.G.: Bericht 1969, p. 33.

TABLE III
EDUCATIONAL LEVELS OF STUDENTS SUPPORTED BY THE FOUNDATIONS (1)
1964

	Number	Percentage
<u>Having Gained</u>		
Promotion	45	2
Diploma, state examination or equivalent	468	18
Pre-diploma (2) and equivalent	998	37
No examination passed	1,168	43
	2,679	100

(1) i.e. the Begabtenförderungswerke

(2) Vorprüfung

If we consider all students supported with the funds of the V.W. Foundation - however the money is channelled - we find that of 2,541, 56 per cent are working for their doctorate (the figure is much higher for those in universities than in technical universities) and 20 per cent are taking conversion courses. That is to say, this Foundation does concentrate its funds in the postgraduate field. There is also concentration within fields of study and, again, if one considers the 1,369 recipients of Promotionsstipendien, the distribution by fields of study differs considerably from that of all students (data on all promoted, or postgraduate, students was not available for comparison). This is shown by Table IV. Notably favoured are law, humanities, and natural science; notably under-represented are medicine and the applied sciences. However, to some extent this must represent the differing tendencies to do postgraduate work. [If one considers the distribution of all stipends awarded directly by the foundations, not just the postgraduate stipends, the differences are reduced. Thus, medicine receives 9 per cent, applied sciences 10 per cent⁷ (1).

(1) See Begabtenförderung oder Elitebildung? Table 25, p. 75.

TABLE IV
SUBJECT DISTRIBUTION OF POSTGRADUATE STUDENTS
SUPPORTED BY V.W. FOUNDATION MONEY AND OF ALL STUDENTS
(1964)

Subject	Promotionstipendien		All Students	
	Number	%	Number	%
Theology	64	5	8,069	4
Medicine/Pharmacy	59	4	38,549	16
Law	179	13	19,909	8
Social science/Economics	220	16	37,848	16
Humanities	443	32	45,420	19
Natural science	329	24	34,071	14
Applied science	39	3	35,601	15
Other	34	3	18,116	8
No information	2	-	50	0
Total	1,369	100	237,633	100

[In the two studies from which these data are taken, a good deal of further information on distribution by institution, socio-economic status of family, etc., is given. We cannot follow the studies into such detail here.]

In summary, we have only partial information on the support of postgraduate students. Many are supported either directly by one of the Begabtenförderungswerke or indirectly by the V.W. Foundation, and some information is available on this. [Such support is generally for either 1 or 2 years.] The V.W. Foundation has perhaps been the body which, above all others, public and private, has given particular attention to the support of postgraduate study. The situation is now changing and the Federal Government has formulated a support policy which will considerably transform the general pattern over the next few years. This will be considered in the following section.

(g) The Future Situation, and Government Policy

The Federal Government has recently put forward a scheme for the support of postgraduate education (Graduiertenprogramm) which will come into effect during 1971. Students will be eligible who have passed the examinations which in their discipline admit entry to doctoral study. In 1971, 5,000 postgraduate scholarships will be made available; in 1972, and in each subsequent year, 10,000 new ones, each lasting for two years. In 1966, 7,200 doctorates were awarded. Since 20,000 two-year studentships are to be awarded by 1974, it would appear that a very considerable proportion of the students working for their doctorates will receive support for part of that time. The cost of the programme - met largely by the Federal Government - will rise from 60 million DM in 1971 to a plateau of 240 million in 1974. There is to be no earmarking with respect to disciplines, at least at the beginning of the scheme, and although some rules may be laid down, the actual choice of students will be left to individual universities.

In section IV, the reasons are discussed for the introduction of this new scheme of finance, deriving essentially from the need to expand the number of university teachers.

III. THE NATURE OF THE DOCTORATE

We have already pointed to the wide variation in the nature of the doctorate between academic disciplines in Germany and, sometimes, between universities within a given discipline. In no discipline can the German doctorate be considered a training for research in the sense that it is known in the United Kingdom or United States; nor is it so intended. Nevertheless, there are disciplines, and universities, in which the standard is set sufficiently high that in terms of academic attainment it does approximate to the Ph.D., even though, again, it may not be considered as a training in research. Unfortunately we have no information on variations between universities, and so generalisations as between disciplines are extremely susceptible to rapid falsification. We may tentatively say that in the philosophical faculty the doctorate cannot be considered as postgraduate work: a preliminary examination is rarely necessary. Of course, the state examination will nevertheless be taken by many students in the humanities because many of these will wish to seek employment as high school teachers. In law, the state examinations confer the right to practice; the first is taken after 4-5 years, and the second after another 2-3 years which include practical work as a lawyer. Students generally need to have reached a certain standard in these examinations in order to submit for a doctorate. They may embark upon their dissertation work either after the first or after the second examination. It is not uncommon for lawyers to take the doctorate, principally for reasons of social prestige. A similar situation exists in medicine. Although it is the state examinations which confer the right to practice, virtually all medical graduates write the thesis leading to the doctorate. In both these faculties, the theses must vary greatly in quality; only those (relatively few) who may prefer academic employment to the practice of their professions will write "real" dissertations. In the social sciences the situation almost certainly differs so much between universities that one cannot generalise. It is probably true, however, that in economics a preliminary diploma is generally essential before embarking upon doctoral study. We are left with the natural science and technological faculties. In these the preliminary diploma is almost inevitable. Doctoral work is also of variable quality, but it is here that it perhaps most nearly approaches postgraduate work as it is known in English-speaking countries. Even so, it is not a professional training and in no sense confers the expectation of an academic career. Indeed, for chemists entering industry the doctorate is almost de rigueur. (The same is not true for technologists.)

Table V gives estimated transition ratios (or promotion ratios in German usage) for three disciplines in which the doctorate is reasonably considered as postgraduate work. An equivalent figure is given for all natural sciences. The main conclusions which may be drawn are the following. Almost all those graduating with the diploma in chemistry proceed to work on a dissertation. In mechanical engineering only about 13 per cent do so. In both cases the figure has remained fairly constant. By contrast, in natural sciences as a whole (including mathematics, pharmacy), the percentage promoted has fallen in ten years from over half to just over one third. In economics, too, it has fallen from 22 per cent to 13 per cent. To some extent this must follow from the increasing acceptability to employers of the lower degree.

To calculate such ratios in disciplines like the humanities is meaningless, in medicine valueless. Estimates of this kind thus have a more restricted conceptual significance than they have in many other countries. Because of the organisation of advanced studies such estimates are perhaps of less interest to the policy-maker than they might be in the United Kingdom, for example. The lack of formal provision for postgraduate education (which is discussed below) results in reduced resource implications from high transition ratios.

TABLE V

ESTIMATED TRANSITION (OR PROMOTION) RATIOS (1)
IN SELECTED AREAS OF STUDY 1953-1962

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
All natural sciences (2)	(.56)	(.55)	.56	.53	(.54)	(.48)	(.45)	(.42)	(.40)	(.37)
Chemistry	(.86)	(.80)	(.88)	(.87)	(.96)	.99	.94	(.93)	(.88)	(.87)
Mechanical engineering	(.14)	(.14)	.13	.12	.12	(.13)	.14	.14	.13	.12
Economics (3)	.22	(.22)	.20	(.17)	.15	.16	.15	.14	.14	.13

(1) Since we do not know the exact duration of doctoral studies, we have proceeded as follows. In each case, lags of both two years and three years between first and second degree have been postulated and transition ratios calculated. These have then been averaged to give the figures in the table. Values in brackets indicate that the two estimates differed by more than 0.02; in other cases the two values agreed to 0.02.

(2) Includes those classified in German statistics not under particular disciplines but as having passed the teaching examination in natural sciences.

(3) Including political economy, industrial economics and engineering economics.

The period between the receipt of the first and second degrees in Germany can not usually be considered as training in research, for there is no formal instruction. It is essentially the didactic use of research for education. Although a number of professors may hold seminars for doctoral students, these are rarely compulsory and may often take the form simply of each of the professor's students discussing, in weekly succession, his own particular work. Students having once passed the necessary examinations (if any), and having been accepted as candidates for the doctorate, need have little further contact with the university until their dissertation is complete. There is no real system of registration, hence no postgraduate enrolment statistics. The situation is of course somewhat different in laboratory subjects.

A fairly recent survey of faculty and students in two medium sized universities (1) asked members of faculty their opinions as to the number of students presently working for their doctorates: was it too high, too low, or right. On average, and particularly in the scientific disciplines, many professors would have liked more students. Taking all disciplines together, 8 per cent thought the number too high, 55 per cent right, and 29 per cent too low (8 per cent did not answer the question). In the pure sciences, the voting was 8 per cent too high, 46 per cent right, and 34 per cent too low. In other words, in spite of the poor quality of instruction at this level (or because of the small amount of educational effort required), and the length of time taken to attain a standard not comparable with the Ph.D., over one third of science professors would like more students.

The motives of students in pursuing advanced studies are also of interest. A survey of those in receipt of a stipend from the V.W. Foundation inquired into students' motives. The results are reproduced in Table VI.

In the majority of disciplines "general interest in research" is the single most popular motive, except in medicine where the doctorate is regarded by almost half as "the only possible termination to study" and, interestingly, in natural sciences, where improvement in professional opportunities is seen as most important. Although relatively few regarded the doctorate as essential to their professional career prospects, over one third saw it as important. This becomes the second most popular motive. Few admit to the attraction of the social prestige attached to the title doktor.

That the desire to become a university teacher does not underlie doctoral study in Germany may be shown by considering the numbers Habilitating. Habilitation is still a pre-condition for an academic career, although many wish it otherwise. Table VII gives the numbers Habilitating, by faculty, in 1960 and 1966.

It is possible, very roughly, to compare these numbers with the numbers of those awarded doctorates several years earlier. If we assume that Habilitation takes 5-7 years, we find that the percentage of those in natural sciences who must have embarked upon an academic career (in about 1960) was 19-23 per cent of those awarded doctorates. In the social sciences an equivalent figure would be 8-9 per cent, in medicine 7-9 per cent. There is no direct evidence on the employment of those receiving doctorates, but these figures give some indication of the extent of selection of an academic career. Further relevant though scarcely conclusive information is available from the surveys of foundation-scholarship holders, which have been cited already. These figures, given in Table VIII, refer to students both before and after promotion, and would thus be clearly

(1) Survey of the University of Göttingen and the T.H. Hannover. See Gebhardt (loc. cit.), Table 25, p. 118.

TABLE VI

MOTIVES FOR PURSUING DOCTORAL STUDY:
PERCENTAGE OF STUDENTS IN DIFFERENT FACULTIES
ACKNOWLEDGING PARTICULAR MOTIVES

Number of Respondents	Theology (64)	Medicine (59)	Law (179)	Social Science (220)	Humani- ties (443)	Natural Science (329)	Applied Science (39)	Other, No response (36)
<u>ACADEMIC MOTIVES</u>								
General interest in research	38	33	45	42	36	29	49	6
Interest in a special problem	28	14	19	16	11	7	18	36
Stimulus of examination work	25	5	17	13	19	12	8	11
Through teaching	14	0	3	4	10	2	5	8
Because of good student performance	5	5	9	9	4	2	5	6
As useful termination to studies	22	8	11	19	10	16	10	28
As the only termination to studies	0	44	1	9	18	18	0	33
<u>PROFESSIONAL MOTIVES</u>								
Doctorate necessary for professional career	13	5	8	17	22	18	15	19
Professional opportunities improved	30	12	34	29	25	40	23	19
<u>SOCIAL PRESTIGE OF TITLE</u>	0	5	10	5	2	1	0	3

subject to change if only postgraduate students were considered. Secondly, they represent students' anticipated professions - hopes and expectations may change. Thirdly, the students involved are something of an academic elite.

Clearly, the academic profession exercises a particular attraction on students of natural sciences and the humanities; far less so for those in applied and social sciences. This general qualitative conclusion is borne out by the relative percentages (as estimated earlier) going on to do doctorates and subsequently Habilitation.

TABLE VII (1)
HABILITATIONS AWARDED (BY FACULTY)

	1960	1966
Theology	18	20
Philosophy (Humanities)	57	74
Law	14	30
Social science	19	32
Medicine (2)	146	174
Natural science	97	214
Agricultural science	15	24
Other Technology	19	48
TOTAL	385	616

(1) W.R. (1967) pp. 318-9.

(2) Including veterinary science and dentistry.

TABLE VIII

ANTICIPATED CAREERS OF STUDENTS RECEIVING FOUNDATION SUPPORT BY FACULTY

(Percentages)

Profession	Faculty							Total
	Theology	Medicine	Law	Social Science	Humanities	Natural Science	Applied Science	
Free professions	-	31	9	10	4	1	18	8
Employment	4	11	5	15	5	18	27	12
Civil servant (excluding academic)	46	-	18	14	36	11	8	21
University teacher	8	17	5	8	19	20	6	15
Other	9	3	2	5	2	3	3	3
No information given	33	38	61	48	34	47	38	41

TABLE IX

AVERAGE DURATION OF DOCTORAL STUDY (1)
IN GÖTTINGEN UNIVERSITY AND T.H. HANNOVER
FOR SELECTED AREAS OF STUDY (1964-65)

	Göttingen				Hannover		All
	Law	Arts	Science	Social Science	Science	Mech. Eng.	
Duration in semesters (= ½ year)	6.2	7.5	6.6	8.0	7.0	8.4	7.0

(1) Promoted students' estimate

The same study also permits comparison of students' and supervisors' (Doktorväter) estimates of the length of study needed to complete the dissertation. This is rather interesting. Taking all faculties and both universities together we have:

TABLE X

COMPARISON OF ESTIMATED AVERAGE LENGTH OF DOCTORAL STUDY (1)

Number of Semesters	% Students Estimating	% Supervisors Estimating
3 or less	5	5
4	5	27
5	18	16
6	16	36
7	17	3
8	13	12
9	10	0
10	5	1
11 or more	11	0

(1) Promoted students' estimate

In other words, professors consider the time taken to be very much lower than do the students. This hardly indicates a situation of mutual understanding.

We have already pointed out that a rather large (though unknown) number of doctoral students are employed as assistants in universities. In common with other countries, and especially with the United States, the heavy obligations associated with such employment extend somewhat the time taken to complete dissertations. This must increase the average time taken.

We do not know how many students who begin work on their theses fail to complete them and are thus barred from the final doctoral examination. It has been suggested, however, that this percentage, the "drop-out rate", may be over 50 per cent.

IV. CURRENT PROBLEMS, AND POLICIES FOR REFORM

Germany has a long tradition of intellectual interest in the problems of science, of knowledge and of universities. There is thus no shortage of discussion of the current problems of universities, but it cannot be said that the problems of postgraduate education loom large in such discussion. Germany's post-war wealth, and full employment both of workers and of cadres, have de-emphasized the problems of matching manpower supply and demand. Discussion has principally centred upon the structural problems of universities, upon the explosion of higher education and upon student unrest. Within all this, however, certain questions have been raised which have implications in the context of this paper. The account which follows will deal with three of these:

- (a) the reform of academic studies,
- (b) the finance of university studies,
- (c) the trend towards university specialisation and the creation of centres of excellence.

We must reiterate that these are not seen as problems specific to postgraduate study. This is partly because postgraduate education is less distinct a part of higher education than in other countries. So far as (a) and (b) are concerned, the organisation and finance of doctoral study are discussed within the general context of reforms in higher education. So far as (c) is concerned, policy has been principally concerned with the organisation of research. The concentration policy, the creation of centres of excellence (Sonderforschungsbereiche), is principally associated with the W.R. and financed by the D.F.G., which has no educational training function. All of them, however, have important implications for postgraduate study.

(a) The Reform of Academic Studies

This has been one of the major concerns of the Wissenschaftsrat, and two of its reports are of particular significance here (1). The W.R. has suggested that varying percentages of the age group should receive education of different lengths, as follows:

2-3 years of higher education	15-18%
approximately 4 years study of higher education	5- 6%
would receive 4-6 years of higher education	5- 6%
	<u>25-30%</u>

Then 2.3 per cent of the age group (i.e. about 10 per cent of those receiving some higher education or 20-25 per cent of those receiving four years or more) would proceed with Aufbaustudium, or postgraduate education (2).

The W.R. has also been anxious to find ways in which the studies themselves could be reorganised and in the 1966 Report gives detailed examples for chemistry, electrical engineering, medicine, and German. The major problem at the postgraduate level

(1) Empfehlungen zur Neuordnung des Studiums an den wissenschaftlichen Hochschulen (1966)
Empfehlungen zur Struktur und zum Ausbau des Bildungswesens in Hochschulbereich nach 1970 (1970)

(2) See 1970 Summary Report, p. 23.

is to formalise the work leading to the doctorate; to integrate it with the earlier phases of study and to increase its educational value. There has to be both a greater division between the third and earlier cycles (i.e. the status of the first degree has to be established) and a greater degree of integration.

Possibly a more useful way of regarding the proposed changes is as the attempt at professionalisation of the doctorate.

The Wissenschaftsrat is a most prestigious body and its recommendations are likely eventually to lead to reform, but principally via their slow modification of public opinion. The feeling is, however, that the 1966 recommendations on reform of the curriculum have been implemented only to a very slight extent as yet.

(b) The Finance of University Studies

Just as doctoral study has been principally regarded as a part of general education and in no sense a professional training, so it has been financed in the same way as general higher education. Public sources of funds have not had any particular policy towards the specific support of postgraduate education. The Research Council, which in many countries is a major source of scholarships for research students, has no such role in Germany. Nor has any other official body the mandate to study the need (or demand or supply) for cadres educated to this level (1). All this may be said to follow from the non-professional nature of the German doctorate. It would appear that only the V.W. Foundation has deployed its funds for the support of university students in the light of an appreciation of the specific needs of, and for, those pursuing doctoral study.

The situation is now going to change. Projections have shown that the number of students in German universities is likely to more than double its present figure of 440,000 over the next decade. The need for an expansion in the number of university teachers is acute. Current methods of financing doctoral study were felt to be inadequate. They were also felt to be expensive: paying an assistant a full academic salary while he is also attempting to write a dissertation was felt to be an expensive way of training. Considerable amounts of money are to be made available, through the universities, and indirectly through the Federal Ministry for Education and Science, to provide stipends for up to 20,000 students at a time. This method of distributing the money, it should be noted, is in line with the reasons which lie behind the policy. In many countries in which research studentships are predominantly made available by a research council (e.g. Canada, United Kingdom), the doctorate is regarded as part of the training of scientists. In Germany, it is coming to be regarded as part of the training of university teachers.

(c) Increasing University Specialisation

The principle that in an age of mass higher education universities will increasingly have to specialise in one or another field of research has been accepted and implemented to a greater extent in Germany than elsewhere. The original conception of Sonderforschungsbereiche was laid down in the 1960 Report of the Wissenschaftsrat. In part it represents a response to the increasing costs of modern science, in part a response to the difficulty of introducing new (e.g. inter-disciplinary) sciences into a rather inflexible academic system. In practice, the Wissenschaftsrat draws up and periodically

(1) In fact, a planning group to investigate the future demand for research manpower has just been established in the D.F.G.

revises a list of research areas in which the creation of centres of excellence is felt to be appropriate. Universities may apply for money in order to create a programme in one of the selected fields - or they may propose a new field themselves - and their applications are evaluated by the D.F.G. in terms of the needs of the country and the capabilities and potential of the individual university. The majority, though by no means all, of the research areas are with the natural sciences.

An inevitable corollary of specialisation in research is specialisation in post-graduate education and, to some extent, in the education which is offered to undergraduates. We are not saying that adverse effects for education are inevitable, but undergraduate education could become increasingly specialised if, for example, all chemists in the University of Mainz were to be specialists in macromolecular chemistry. This is an extreme and impossible example, but the danger exists and is worthy of concern. It is a policy which derives from the needs of research, in Germany as elsewhere, but which has implications for education which may have been given less consideration than others and which are hard to assess.

SOURCES OF TABLES

Table I	OECD: <u>Development of Higher Education, 1950-1967, Statistical Survey</u> (Paris, 1970).
Table II	Bengeser: <u>Doktorpromotion in Deutschland</u> , quoted Gebhardt, pp. 26-7.
Table III	von Ferber, Gebhardt, and Pöhler: Table 25, p. 56.
Table IV	Gebhardt: Table 8a, p. 64.
Table V	Estimated, using data from W.R. (1967): Table 12, pp. 302-307.
Table VI	Gebhardt: Table 17, p. 93.
Table VII	W.R. (1967): Table 14, pp. 318-9.
Table VIII	von Ferber, Gebhardt, and Pöhler: Table 35, p. 99.
Table IX	Gebhardt: Table 24a, p. 112.
Table X	Gebhardt: Table 24b, p. 114.

BIBLIOGRAPHY

Sources Consulted

Deutsche Forschungsgemeinschaft: Bericht, 1969.

- Wissenschaftsrat: 1. Empfehlungen zur Neuordnung des Studiums an den wissenschaftlichen Hochschulen (May 1966).
2. Empfehlungen... zum Ausbau der wissenschaftlichen Hochschulen bis 1970 (July 1967).
3. Empfehlungen... zur Struktur und zum Ausbau des Bildungswesens im Hochschulbereich nach 1970 (June 1970).

D.A.A.D. (German Academic Exchange Service): Higher Education in the Federal Republic of Germany - Problems and Trends (1966).

C. von Ferber, F. Gebhardt, W. Pöhler: Begabtenförderung oder Elitebildung? (Göttingen, 1970).

F. Gebhardt: Promotion und Stipendium (Göttingen, 1967).

OECD: Innovation in Higher Education: Three German Universities (Paris, 1970).

Development of Higher Education 1950-1967, Statistical Survey (Paris, 1970).

F. Paulsen: The German Universities and University Study (English edition 1906).

ANNEX D

ANNEX D

POSTGRADUATE EDUCATION IN NORWAY

TABLE OF CONTENTS

	<u>Page</u>
I. <u>GROWTH AND TRANSITIONS</u>	193
II. <u>SOURCES OF FINANCIAL SUPPORT</u>	195
III. <u>RESEARCH AND NON-RESEARCH POSTGRADUATE EDUCATION</u>	198
IV. <u>THE NATURE OF POSTGRADUATE RESEARCH</u>	198
(a) History and Growth	198
(b) Transition Ratios by Field (not available)	200
(c) Content, Duration, and Success or Failure	200
(d) Contribution of Postgraduate Work to Research	204
(e) Unorthodox Research Degree Schemes	204
V. <u>OTHER POSTGRADUATE WORK</u> (No Information)	206
VI. <u>SUBSEQUENT EMPLOYMENT</u>	209
VII. <u>POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM</u>	212
SOURCES OF TABLES	215

I. GROWTH AND TRANSITIONS

A major difficulty in discussing postgraduate education in Norway lies in defining, in terms of degrees awarded, what constitutes such education. This is best made clear by an historical account of the degree system of Norwegian universities. In science and the humanities (not applied sciences) a system of unrestricted entry at age 19 traditionally led, after a rather prolonged period of study, to the degree of cand. real. (science) or cand. philol. (humanities). [Applied scientists, who were admitted to the Technical University at Trondheim subject to a numerus clausus, studied for even longer and received the degree of sivilingenjör.⁷

These traditional degrees were, and are, a necessary qualification for those who wish to teach in the higher secondary schools (gymnasia). In 1920 a new degree, cand. mag., was introduced as part of this traditional course in both sciences and the humanities. Cand. mag. was to be taken after about 4 years of study (not in engineering or other professional fields), and cand. real. or cand. philol. after a further two years or so, involving the writing of a thesis. Thus, in those fields in which it is awarded, cand. mag. is the equivalent of the bachelor's degree. However, whilst cand. real. and its equivalent have long been qualifying degrees associated with a particular career, the new bachelor's degree is less well established as a qualification in its own right (1). The difficulty therefore has not been in establishing the value of the higher degree but rather that of the first degree, which was long regarded as a "drop-out" degree. [A rather similar dual degree system was introduced quite recently in the social sciences.⁷ The doctorate in Norway is obtained by very few; the study for it is not carried out on a full-time basis and it is awarded only on production of a rather substantial thesis. The median age of recipients in science is now about 39 years. This degree, which can be compared with the French doctorat d'Etat, is generally taken only by those teaching in higher education. Thus, the situation is that because of the high prestige of the cand. real., or its equivalents, and the rather low prestige of the first degree (cand. mag.), a very considerable proportion of students go on to do what we must consider as postgraduate work. The proportions in science taking the three levels of degree are roughly expressed, for the mid-1960's, by the following block diagram:

3rd degree	10%	(<u>dr. phil.</u>)
2nd degree	80%	(<u>cand. real.</u>)
1st degree	100%	(<u>cand. mag.</u>)

We have already noted that the degrees awarded in engineering and technology are rather different. The traditional degree, siv. ing., takes about 4½ years - longer, that is, than degrees in other fields. This was supplemented in the 1950's (not divided) by the addition of a degree, the licentiate, obtainable after a further two years' study and research. The data presented in section IV(a) show that few students in these fields stay on to take the licentiate.

Transition Ratios

Transition ratios between first and second degree levels by field are not collected in Norway, although an indication has been given of the very high percentage of

(1) Though it does entitle the holder to teach at the lower secondary level.

science students who do stay on for further study. However, since there is a strong feeling that drop-out from the cand. real. course is very low (i.e. most candidates obtain the degree), it is possible to make estimates. This is done in Table I. The official minimum duration of the cand. real./cand. philol./cand. oecon./licentiate degrees is two years; in practice, the average duration lies between two and three years. The basis of the estimate, made for natural science, humanities, and all subjects, is given in a footnote.

TABLE I
ESTIMATED TRANSITION RATIOS BY BROAD FIELD BETWEEN
FIRST AND SECOND DEGREE LEVELS (selected years) (1)

	1953-54	1955-56	1958-59	1960-61	1963-64	1965-66
Basic sciences	.98	.93	.86	.54	-	.73
Humanities	.64	.54	-	.48	.34	.43 (.43 1966-67)
All fields of study	-	.15	.15	.14	.21	.23 (.23 1964-65)

(1) Ratios were calculated by comparing 2nd degree graduates with 1st degree graduates on both a 2-year and 3-year delay basis. Only when these agreed within .08 were figures taken to be meaningful, and the two averaged to give the ratios in Table I.

N.B. Excludes postgraduate teacher training.

Thus, a very much higher proportion of students in basic sciences than in other fields stay in university for further study/research. The figure for "all fields" is low because relatively few students in professional fields stay on (including engineering, medicine and agriculture students whose first degree is of higher standing than in the pure sciences or humanities); these constitute about 50 per cent of graduates at the first level.

So far as trends are concerned, it would appear that the tendency to stay on is increasing in non-scientific fields, although slowly. In science, one can say that the transition ratio definitely fell quite considerably over the period 1953-1965 - a period of rapid expansion of the universities. The trend in recent years is not clear from the table, but opinion in Norway is that there is currently a continuing reduction.

Enrolment data do not distinguish students by level of studies, and in order to make an international comparison of the percentage of students enrolled who are working for higher degrees a further estimate must be made. This is done, in a somewhat simplistic fashion, in Table II, in which the enrolment in year x is compared with the number graduating at the higher levels in $\sqrt{\text{year } x + \text{year } (x + 1)}$.

TABLE II
ESTIMATED PERCENTAGES OF ALL ENROLLED STUDENTS
WHO ARE WORKING FOR HIGHER DEGREES (1)

	1951-52	1954-55	1957-58	1960-61	1963-64	1964-65
Percentage	38	34	28	23	20	19

(1) N.B. Excludes postgraduate teacher training.

If this is a meaningful method of estimation, it can be said that postgraduate enrolments represent a decreasing proportion of the total in Norwegian universities (2).

II. SOURCES OF FINANCIAL SUPPORT

Norwegian higher education is free, and from the point of view of the proportion of working-class children participating, Norway is second only to the United Kingdom in Europe (3). Government funds are readily available, although on a loan basis. It must be borne in mind that preparation for cand. real. and its social science and humanities equivalents (though not the licentiate in applied sciences) is considered to be, and financed as, a continuation of education rather than as training for research. We have already seen that, in natural sciences at least, a very large percentage of students go on to this research level and their studies are for most the part financed similarly to their second cycle studies. In contrast to countries in which third cycle education in science is generally considered a training in research and students are consequently financed from scientific funds, in Norway cand. real. students are financed in the same way as cand. mag. students. The finance of this level of work is not regarded as an instrument of science policy and cannot be judged as such, in contrast to the finance of Ph.D. work in the United Kingdom or Canada, for example. The needs of science as such enter only at the post-cand. real. level. Some 50 per cent of cand. real. students receive state loans. The amount of these loans used to be based upon parents' income, but this is no longer the case. Many do other jobs to bolster their incomes; a considerable number are supported by their wives, and a few may be engaged as "assistant teaching assistants" to do a small amount of teaching in the universities.

The programme of student support which the Research Council for Science and the Humanities once operated has been reduced to an average of 25 students per annum. About 15 of these studentships are for medical students to interrupt their medical training, which lasts for 7-8 years, in order to train them in medical research. The others are devoted to the training of students working in fields of relevance to Norway's programme of technical assistance to developing countries.

(2) We have assumed here that the second degree lasts two years. If we assume that it lasts $2\frac{1}{2}$ years we could compare the enrolments in year x with graduations in $\frac{1}{2}$ year $x + 1) + \frac{1}{2}$ year $(x + 2)$. If we do this, all the percentages are increased but the downwards trend remains. Figures for 1951-1952 and 1963-1964 become 46 per cent and 25 per cent, respectively.

(3) "Group Disparities in Educational Participation", Background Study No. 4, OECD Conference on Policies for Educational Growth, Vol. IV (Paris, 1970).

There is a general feeling among policy-makers in Norway that education to the research (cand. real.) level is an education of value to far more than those whose eventual careers will be in scientific research. What is more, although the feeling exists that too many students do stay on, the financial burden which this imposes on the state does not seem to be thought insufferable. Thus, the control of student numbers at this level is not a major priority and student finance in the form of loans is quite readily available. Scientific manpower considerations only really enter at the next stage - in the provision of fellowships and assistantships.

For completeness, an outline will be given here of the provision of, and policy with regard to, assistantships and fellowships although it does not properly belong in the present study (1). We shall consider those provided by the three major sources of funds for such posts: the Council for Scientific and Industrial Research (N.T.N.F.), the Research Council for Science and the Humanities (N.A.V.F.) and the universities. Awards are also provided, though on a smaller scale, by the Agricultural Research Council (N.L.V.F.).

Table III gives the total numbers of both classes of personnel (known jointly by the term "rekrutteringspersonale") by major groups of discipline and by major sources of funds. The major differences between the two types of award are in the ways in which they are obtained, and in the duties which they entail. Fellowships are distributed through a competitive process by the research council or institute. Their duties are minimal - generally only 1-2 hours of teaching per week; they represent a means whereby the most promising researchers can get on with their own work. Assistantships are far more in the gift of the individual professor, who may obtain a research/teaching assistant from institute or research council funds. His duties will typically entail at least half of his time spent on teaching or his sponsor's research. He thus has far less time for his own research. Salaries in both cases are linked with those of secondary school teachers.

Recruitment awards from university funds

Each institute is allowed a certain number of each type of award from university funds. Table III shows that the number does not vary much between the major faculties of science, social sciences, humanities and technology. Similarly, each institute is allotted a certain number of assistantships; here the numbers vary far more. Numbers are related to the number of students to be taught.

Recruitment awards from N.T.N.F. funds

The N.T.N.F.'s major fellowship programme is designed to permit study abroad, although in 1969 five fellowships out of forty-nine were held in Norway. The programme is discussed further in section IV(e). Assistantships are paid for from research grants. Grants for research, principally at the Technological University of Trondheim, are frequently used partly to pay for a research assistant. At the present moment seventy such assistants are financed in this way. It is possible for such an assistant to work for the licentiate degree (as it is for a fellowship holder) but this is not encouraged by the N.T.N.F. Assistantships are not regarded as a means of financing further study, but of financing research.

(1) Except in that candidates for the licentiate degree in technology do frequently hold a fellowship or assistantship; this is not usual among higher degree students in other disciplines.

TABLE III

POSTGRADUATE RECRUITMENT AWARDS BY FIELD, TYPE, AND SOURCE OF FUNDS IN 1968

Field	Source					
	University		N.A.V.F.		Other, including N.T.N.F.	
	Fellowships	Assistantships	Fellowships	Assistantships	Fellowships	Assistantships
Humanities	25	31	37	4		2
Natural sciences	32	262	48	56		60
Technology	34	101	4	2		60
Social sciences	19	56	25	44		28
Medicine	27	80	45	2		55
Dentistry	2	25	0	0		0
Architecture	5	9	1	0		2
Agriculture	1	39	2	0		31
Theology	5	4	2	0		2
Law	6	14	2	1		1
TOTAL	156	621	166	103		241

Recruitment awards from N.A.V.F. funds

The N.A.V.F. awards fellowships as a result of a process of selection of individuals. The individual graduate chooses a project and a supervisor (although he may receive only the minimum of supervision), and applies. Until quite recently awards were made entirely on the basis of the quality of the applicant, and all the most highly qualified applicants were successful. At the moment, a policy of relating the numbers of awards made in each discipline to national manpower requirements is in process of introduction. Quotas will be allocated to fields of study, determined in part by the availability of future jobs. However, research groups of the highest quality will receive special consideration. [In section VI it is pointed out that this programme would be a major means of financing Ph.D. studies as they are known in the United States, etc., if such a degree were to be introduced.] It should also be pointed out that only a minority of awards made by N.A.V.F. are financed from the Council's own funds (derived from the proceeds of the national state football pool); the vast majority are financed from a special state grant to the Council for this purpose. The N.A.V.F. also awards assistantships as part of research grants in a parallel fashion to the N.T.N.F.

III. RESEARCH AND NON-RESEARCH POSTGRADUATE EDUCATION

We are not specifically concerned in this study with professional postgraduate education, and all other third cycle education appears to be of a research nature. There are no advanced training degrees, such as some American or British master's. Postgraduate medical education, a specialist subject not susceptible to general treatment in a paper of this kind, presents a curious picture to the student of Norwegian policy-making. This is essentially because responsibility for each of the three major phases of medical education is vested in a different body: pre-clinical education in the Ministry of Education and the faculties; clinical education in the Public Health Authority, and postgraduate education in the Norwegian Medical Association. Clearly, this would lead to difficulties in planning unless consultation were unusually good (1), although in financial terms the Ministry of Education is responsible for the finance of both the clinical and pre-clinical stages.

IV. THE NATURE OF POSTGRADUATE RESEARCH

This section of the paper is concerned with the work and the situation typically leading to the award of the doctorate, of the can. real. and equivalent degrees, and of the licentiate in engineering. The emphasis will be on the second of these because it is taken by very large numbers, whereas the others are not.

(a) History and Growth

Attention has already been drawn (in section I) to the historical connections between cand. real. and school teaching, and between the doctorate and university teaching (although the doctorate is not essential for university teaching). The difference in numbers at these two levels is striking.

(1) See A. Marthinsen: "Responsibilities for Change in Medical Education", Journal of the Norwegian Medical Association (special Commemorative Issue, in English, Oslo, May 1970), p. 44.

TABLE IV
NUMBERS OF ADVANCED DEGREES AWARDED

Year	Cand. Real.	Cand. Philol. Cand. Oecon.	Lic.	Total	Doctorate in Science	All Doctorates
1921-25 (av)	10	n.a.	0	n.a.	3	14.5
1931-35	27.5	n.a.	0	n.a.	3	14.5
1941-45	32	n.a.	0	n.a.	n.a.	n.a.
1951-55	82	n.a.	0	n.a.	n.a.	n.a.
1956-59	84	57	0	7	7	39
1961-62	89	65	10	164	8	31
1964-65	164	104	14	282	14	49
1965-66	192	142	20	354	11	59
1966-67	n.a.	163	17	n.a.	n.a.	n.a.

The above table gives an indication of the growth in higher degrees awarded. The very small number of doctorates should be noted and the sudden expansion at cand. real. level between 1961 and 1965, following a rapid rise in enrolments from about 1960.

Education abroad

This is perhaps a suitable place to draw attention to a curious aspect of the training of Norwegian researchers, if not of Norwegian education itself. It is not possible to understand the Norwegian higher education system without appreciating its effective augmentation by the training of Norwegians abroad, because this occurs principally in the professional fields (e.g. medicine and dentistry, engineering) which in Norway are subject to a numerus clausus, and in research training. The percentage of Norwegian undergraduate students enrolled abroad is falling, being now 11 per cent (1969-1970), compared with 23 per cent in 1960-1961 and 30 per cent in 1956-1957. Although at this level study abroad is probably not officially encouraged, it is accepted: such students are not felt to be lost to Norway. Doctoral study abroad remains common, and Skoie has shown that some 20 per cent of all Norwegians holding a doctorate obtained it abroad. Increasingly they go to America for such study, as shown by Table V below.

TABLE V
DOCTORAL STUDY ABROAD: RECEIPT OF FOREIGN DOCTORATE

Location	Time period			
	1920-1966		1960-1966	
	No.	%	No.	%
Nordic countries	27	10	11	11
Elsewhere in Europe	126	48	34	35
United States	107	41	52	53
Elsewhere	2	1	1	1
TOTAL	262	100	98	100

In other words, since 291 doctorates were awarded in Norway between 1960-1966, 98/389 or 25 per cent of Norwegians obtained their doctorates abroad at this time. However, this does not represent the actual dependence of Norway on foreign countries for the production of the research-educated because, as we have emphasized, the English or American Ph.D. lies between the Norwegian cand. real. and Norwegian doctorate in attainment, and the comparison as made in Table V is unfair to Norway.

(b) Transition Ratios by Field

Transition ratios in individual disciplines are not really obtainable. Students apply to the faculty, not to an individual department, and specialisation in a given discipline is a gradual process. Thus at the cand. mag. level, at least until recently, a chemistry student may have spent only one-third of his time on chemistry instruction. (An equivalent figure now would be about one half.) Numbers of cand. mag. degrees awarded are not broken down by discipline. In section I estimated ratios were given for broad faculty divisions.

(c) Content, Duration and Success or Failure

(i) Cand. real, etc.

On receipt of cand. mag., a large percentage of science students - and smaller percentages of students in other disciplines - stay on to take the degree of cand. real. (cand. philol., cand. oecon., or the licentiate in the Technical University of Trondheim). In theory, the first degree in natural science takes $3\frac{1}{2}$ years, although 4 is more usual, and therefore students entering upon this third cycle education are typically aged about 23. (The engineering degree siv. ing. takes about $4\frac{1}{2}$ -5 years, consequently engineering students are slightly older on average.) The second degree has a minimum duration of 2 years, but it will be shown later that it generally takes an average of $2\frac{1}{2}$ years. The time is spent partly on advanced instruction and partly on research. In chemistry, for example, the time would be spent as follows. At the beginning of the course, the student selects from a large number of short courses, mostly related to techniques of research which he might have to apply later (e.g. chromatography, N.M.R. spectroscopy, X-ray diffraction, quantum-mechanical techniques, programming, etc.). These courses last 12 weeks. He then chooses his research topic and for the remainder of the time pursues advanced courses and research simultaneously. In both chemistry and physics it is estimated that $1\frac{1}{2}$ -2 years are actually spent on research. There was a general opinion that at least 90 per cent of students who embarked upon cand. real. studies were eventually successful.

Table VI shows the distribution of time taken to obtain the degree of cand. real. at different periods. We see that roughly equal numbers take 2 years or 3 years, and that relatively few students are successful in less than 2 years, or take more than 3. This used not to be the case, however, and Table VI shows that the spread in time taken is narrowing. Thus, in 1925-29, 43 per cent of students took more than 3 years, in 1940-44 (an exceptional period, obviously) 56 per cent; whilst by 1950-54 the percentage had fallen to 20 and by 1960-64 to 17 per cent. This reduction in length of studies, especially when it is not the result of legal requirement, is obviously indicative of an improving situation. Since the advanced age at which students become available for employment is a matter of concern in Norway, it is worth looking at this too. Table VII shows the spread in ages for 3 scientific disciplines and for all sciences. If we take the age at which 70 per cent have obtained the degree (an arbitrary percentage) then we see that there are differences between the disciplines and also that the average age is falling:

TABLE VI

TIME ELAPSING BETWEEN FIRST AND SECOND DEGREES

Universities of Oslo and Bergen 1907-66

Time in years

Year of cand. real.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	+20	Total
1907-09	9	10	8	2	1	1		1	1													33
1910-14	6	8	9	3	1	1																27
1915-19	11	9	16	7	5	3		2														53
1920-24	9	18	12	8	6			1	1			1		1								58
1925-29	13	30	42	24	16	10	5	2	2	1		2							1			148
1930-34	15	46	24	20	3	5	1	1		1										1		117
1935-39	31	56	60	28	4	2	3	5	2	3		4	1			1			1	1		202
1940-44	23	37	28	38	26	20	10	12	3	2	1			1		1						203
1945-49	47	89	75	43	19	15	4	6	1		1		1									301
1950-54	70	127	116	42	16	8	5	2	1	1	2	1										391
1955-59	38	142	138	73	19	17	9	3	1													440
1960-64	53	194	204	72	16	2																541
1965	23																					23
TOTAL	348	766	732	360	131	84	37	35	12	8	5	8	2	2		2			2	2	2	2,540

TABLE VII

AGE ON RECEIPT OF CAND. REAL., BY FIELD

Age	Cand. real. year	All fields		Mathematics		Physics		Chemistry	
		1961-66	1954-60	1961-66	1954-60	1961-66	1954-60	1961-66	1954-60
24 or less		5%	3.5%	16%	13%	5%	5%	2.5%	3%
25 "		15%	11.5%	36%	30%	16%	15.5%	10%	11%
26 "		32%	22%	55%	43%	33%	28%	22%	26%
27 "		52%	38%	72%	48%	55%	52%	40%	44%
28 "		67%	54%	84%	57%	72%	68%	57%	59%
29 "		77%	65%	89%	78%	83%	78%	72%	74%
30 "		84%	74%	92%	87%	89%	83%	80%	95%
35 "		96%	95%	99%	96%	99%	98%	96%	
Total		100%	100%	100%	100%	100%	100%	100%	100%
Number		905	452	76	23	242	122	191	115

thus, the age for mathematicians is 27 years, for physicists 28 years, for chemists 29 years. This improving situation - whatever its cause - is to be welcomed, especially when viewed against the rapidly increasing undergraduate enrolments of the 1960s which might have been expected to influence adversely graduate studies. However, as will be seen below, a rather different situation obtains at the doctorate level. This information refers to natural sciences. There is no comparable information on the duration of studies in the arts or social sciences, although on purely a priori grounds one could expect degrees to take rather longer (1).

(ii) Licentiate

The licentiate, principally awarded in applied science subjects, is also composed of a mixture of taught courses and research. It, too, lasts 2-3 years on average, but this is imposed upon a rather longer first degree course. Unlike cand. real., the licentiate is taken but rarely as there is no career for which it is a prerequisite. It would probably not be so regarded even for an intending teacher at the Technical University. A graduate with this ambition would almost certainly do better either to seek an American Ph.D., for which he may obtain state support, or to become assistant to a professor. Hence, in 1966 only 17 licentiate degrees were awarded. So far as industrial employment is concerned, the licentiate is far from necessary. It seems probable that Norwegian industry, like that of other countries, prefers to give its own on-the-job postgraduate training. Perhaps the Norwegian engineering graduate, older than the majority of new graduates, is better able than most to appreciate the employment situation.

(iii) Doctorate

We have suggested that at the cand. real. level, even though the numbers of students staying on are increasing, a gradual improvement is to be observed. Perhaps because studies are more organised, the average age of success is diminishing. At the doctoral level this is not true. Table VIII gives the average age of receipt of the doctorate in Norway at various periods in time.

Not only is the average age exceedingly high, but it is increasing. There is no doubt that Norwegian academics and policy-makers regard this as a major problem. There is a consensus as to the cause of the trouble, which is seen widely as one of lack of formal supervision, or lack of organisation of doctoral studies. Those entering upon doctoral studies will have cand. real., or its equivalent, and will therefore be typically aged about 28 (having also done national service). Almost all will either hold a fellowship - from the university or from the N.A.V.F. - or be employed as a research assistant: the two ways in which aspiring academics can support themselves. In Oslo University, therefore, we see that the physics department, with 60 permanent posts, currently has some 20 fellows and 20 assistants; the chemistry department, with 47 permanent posts, has 25 fellows and 34 assistants. These people, who may be considered as doctorate candidates (2), do not have student status and are not being trained in research. Assistants

-
- (1) There is less pressure from below of incoming students on scarce resources (e.g. laboratory space). Furthermore, there are no fees, and there would seem to be nothing to stop a student writing his thesis on a part-time basis. In general, this is more usual in arts subjects and greatly extends the time taken.
 - (2) It is an approximation to equate these numbers with doctoral candidates: a few assistants - at least in chemistry - could be working for cand. real., though this is rare. Also, a few fellows or assistants might have obtained their doctorates. Tenured posts are frequently not available, and assistantships can be held for up to six years.

are expected to divide their time equally between research and teaching, although the fellows need only devote 10 per cent of their time to teaching. The Norwegian doctorate is thus a substantial piece of work, taking on average 70 per cent of 9-10 years' full-time work. The average time lapse between cand. real. and the doctorate is 9-10 years.

TABLE VIII

AVERAGE AGE OF OBTAINING DOCTORATE AT VARIOUS TIMES, IN VARIOUS SUBJECTS

	Science			Social Sciences			Humanities		
	1920-39	1955-64	1965-69	1920-39	1955-64	1965-69	1920-39	1955-64	1965-69
Average age (years)	35.6	37.7	38.2	36.4	37.4	39.9	37.9	42.6	42.9

A number of proposals have been made for the reform of the doctorate, principally involving the introduction of a formalised Ph.D.-type doctorate of more limited duration. In developing these proposals the provisional assumption was made that the number who would enrol would be about equal to the number of assistants and fellows. These proposals are considered in section VII.

(d) Contribution of Postgraduate Work to Research

It is clearly not possible statistically to evaluate the intellectual contributions to the research effort made by different groups. However, it is useful, and possible, to evaluate the contribution on a purely manpower basis: i.e. men x time. We do this in order to determine the extent to which university research in different countries depends for its execution (if not conception) upon the labours of advanced students. In the Norwegian context we must include permanent members of staff (Fastpersonale), temporary members of staff (Rekrutteringspersonale) of two types: fellows and research assistants, and students working for their second degree (e.g. for cand. real.). In Table IX below an approximate estimate is made in terms of man-hours of the contribution of each to the sectoral research effort in each of four groups of disciplines. Thus, except in natural sciences, the student contribution is relatively slight.

(e) Unorthodox Research Degree Schemes

This section is intended for the discussion of unorthodox methods of obtaining research degrees. In particular it is concerned with the possibilities existing in each country for taking higher degrees outside the universities. The interest in this inheres in the fact that research training in science, in industry and in government, is widely seen as a means of reducing inter-sectoral barriers.

The doctorate in Norway can be taken anywhere; there are no formal residence or instruction requirements. However, because of this, because it can only be regarded as a contribution to knowledge and not as an educational process, this possibility is not of interest. Furthermore, it is to be doubted whether a significant number of the (few) doctorates are taken outside the university. The situation with respect to cand. real. in science is different, and cand. real. research can be carried out in Government or research council institutes, or in industry. Industry employs relatively few holders of the cand. real. degree (see section VI), and it is therefore unlikely that many would

TABLE IX
RELATIVE CONTRIBUTIONS TO UNIVERSITY RESEARCH (1)

	Permanent staff		Fellows		Research assistants		Students		Student contribution
	No.	F.t.e.	No.	F.t.e.	No.	F.t.e.	No.	F.t.e.	%
Science	475	140	110	100	348	170	~~600~~ 7	360	47
Social sciences	208	60	58	50	114	60	~~100~~ 7	60	26
Engineering	216	70	68	60	133	70	~~60~~ 7	40	17
Agriculture	58	20	19	20	54	30	0	0	0

(1) Student numbers estimated from numbers graduating annually (200, 30, 15-20)

Basis of estimate: permanent staff 30% time
fellows 90% time
assistants 50% time
students 60% time

prepare their theses in industry. Preparation in Government and research council institutes does seem to be quite common. Some 20 per cent of those preparing cand. real. in physics at the University of Oslo (i.e. 10 per annum) do some of their work in such institutes, although in chemistry it is much less common (around 5 per cent). In such circumstances the student has two advisors, one in the institute and one in the university. Such work is quite commonly done in the institutes of the N.T.N.F., which include the Central Institute for Industrial Research in Oslo. There are typically some 10-20 students preparing cand. real. in N.T.N.F. institutes, jointly supervised. The N.T.N.F. is particularly concerned to stimulate better relations between industry and the science faculties, itself playing an intermediate role; for although such contacts may be good at Trondheim, they would appear to be less good elsewhere. To this end, a joint committee of the N.T.N.F. and the science faculties has been established. The N.T.N.F. has also made recommendations on the design of an industry-oriented science curriculum to be taken by some of the science students. Finally, a new fellowship programme was initiated towards the end of 1970, designed to train people for industrial research. Very similar to the Science Research Council's C.A.P.S. Programme in the United Kingdom (q.v.), this involves the student contacting an industrial concern or a research institute, and a faculty, and having his proposed research accepted by both. The N.T.N.F. will give a number of fellowships (6-8 initially) for three years to pursue such work. This work would not, however, be likely to lead immediately to any degree. If holders of these fellowships do not go into industry, they ought to introduce some awareness of industrial research problems into the science faculties.

In a sense, study abroad should also be considered here, for, unlike the situation in many industrialised countries, this is both welcomed and encouraged as part of official policy in Norway. Table V shows that some 16 Ph.D.s are obtained abroad annually, and many of their recipients travel with the official sponsorship of the N.T.N.F. or N.A.V.F. Thus, under a fellowship scheme introduced in 1946, the N.T.N.F. finances some 50 students per annum to study abroad, principally in applied sciences. Those selected have generally done 2-3 years' research in a Norwegian university and are expected to

have a personal contact with the group to which they hope to go. Study for a Ph.D. whilst abroad is not encouraged, the emphasis being placed upon the quality of the research. However, since very large numbers tend to go to the United States, and since it is difficult to gain admission to a really good research group without holding either a Ph.D. or registration for one, increasing numbers of fellowship holders wish to take a Ph.D. The obvious danger in a scheme of this kind is of non-return and if this is not a real danger then the contacts so established can be invaluable for a small country. In practice, only about 5 per cent (1) of N.T.N.F. fellows do not return. Before going they sign a contract to work in Norway for a period equal to that spent abroad. Since it has been demonstrated that students who do not return home after their studies are principally those who do not have official sponsorship, and since Norwegians are likely to go in any case, this programme would seem a sensible one. Table X shows the distribution of N.T.N.F. fellows (including N.A.T.O. fellowships administered by N.T.N.F.), by country and field of work.

V. OTHER POSTGRADUATE WORK

The discussion in section IV covers all non-professional postgraduate education.

(1) cf. 35 per cent of those who take their first degree abroad.

TABLE X

FELLOWSHIP AWARDS MADE AND ADMINISTERED BY THE N.T.N.F.

Country	1946-65	1965	1966	1967	1968	1969	Total
Belgium						1	1
Canada	9		2			1	12
Denmark	11	2	3		1	3	20
Finland	2						2
France	17	1	2	1	1		22
Netherlands	24	1		1		1	27
Israel				1			1
Italy	2						2
Norway	49	5	4	2	4	5	69
United Kingdom	136	5	7	14	13	6	181
Switzerland	18						18
Sweden	15		1		1	2	19
Germany	30	1	2	1	1		35
United States	240	19	21	25	30	30	365
Austria	2						2
Other	1						1
	556	34	42	45	51	49	777

TABLE X (Continued)

DISTRIBUTION BY FIELD

	1946-65	1965	1966	1967	1968	1969	Total
Library science	1						1
Biology	2						2
Building	39	3	5	6	10	10	73
Urban planning			1		1	2	4
Computing	12	3	2	1	2	1	21
Electrical engineering	56	3	8	1	5	5	78
Physics	101	7	7	13	8	11	147
Photography	1					1	2
Geography	1						1
Geology	8		1			1	10
Geotechnology	9	1	2	1	3		16
Glassblowing	2						2
Chemistry	201	6	9	16	14	4	250
Agriculture	12	1	1	2	2	2	20
Long-term planning						1	1
Mechanical engineering	57	5	3	4	5	5	79
Mathematics	3	1		1			5
Medical technology						1	1
Metallurgy	21				1	4	26
Meteorology	1		1				2
Operational research	8	1	1				10
Psychology		1					1
Control engineering	17	2				1	20
Sociology	1						1
Transport	2		1				3
Zoology	1						1
	556	34	42	45	51	49	777

VI. SUBSEQUENT EMPLOYMENT

[Holders of the Norwegian doctorate are omitted from this discussion for reasons which have already been stated.]⁷

There are two factors which determine the employment prospects of Norwegian higher graduates: the link between cand. real. and gymnasium teaching, and the preference of industry to employ engineers rather than science graduates. Even though cand. real. is a research training and the sivilingenjör degree is not, and even though large numbers of cand. real. students graduate annually, most industrial research is done by engineers, as the following Table shows:

TABLE XI
MAN-YEARS OF INDUSTRIAL RESEARCH BY QUALIFICATION (1966)

<u>Siv. ing.</u>	579.8
<u>Cand. real.</u>	31.3
Other university qualifications (excludes technicians, etc.)	58.5

A study by the N.T.N.F. does give information on the subsequent employment of holders of cand. real. Tables XII and XIII are taken from that study. It is important to point out that these figures do not refer to first employment but to employment in the reference year 1967. However, the 1965-66 figures (Table XII) may be used as first employment data. These figures are given in Table XIV in percentages of the total. For comparison the current employment of the total stock of holders of cand. real. is also given (post-1920 graduates only) as the best approximation to previous first employment data available.

The data above show that the educational system absorbs nearly 70 per cent of the output. Secondary schools represent the single major source of employment for higher degree graduates in science, with university assistantships/fellowships a close second. There is no other significant single type of employment. Comparison between the two sets of figures indicates that school teaching no longer absorbs as many cand. real. graduates as once it did; it is no longer almost inevitable employment. However, the percentage in the educational sector overall, including higher education institutes, has remained constant; in other words, an increasing proportion is staying to do research in the universities. There may be the makings of a future problem here. Although very few are found in industrial research - and possibly more are performing other industrial functions - the percentage may be rising. This is a healthy sign. There is indeed a widespread feeling among policy-makers that industrial demand for scientists will rise greatly.

TABLE XII

EMPLOYMENT DISTRIBUTION OF CAND. REAL. GRADUATES (in 1967)

Work	Year of graduation	1907 1919	1920 1924	1925 1929	1930 1934	1935 1939	1940 1944	1945 1949	1950 1954	1955 1959	1960 1964	1965 1966	Total
a. School Teaching													
University of Oslo			3	20	85	69	114	140	190	149	216	152	1,138
University of Bergen		1		9	8	8	12	31	34	57	99	90	349
N.T.H.					3	3	2	9	11	29	47	30	134
Other higher education						2	5	2	3	3	4	4	23
N.T.N.F.					1	2	3	3	12	9	10	4	44
N.A.V.F.						2	3	1	20	28	24	12	90
N.L.V.F.					1		3	1		4	23	10	39
Government research institutes				2	1	6		9	1	1	3	2	7
Bransjeinstituttet					1			1	25	24	23	25	120
Independent institutes					1		1	1	2	2	1		7
Industrial laboratories				2	1		3	6	4	6	16	5	34
					2	2			12	12	25	19	83
b. All Research			1	13	18	25	34	64	124	175	275	201	930
c. Other skilled work				2	7	11	15	18	35	16	14	9	127
TOTAL a-c		4	35		110	105	163	222	349	340	505	362	2,195
Housewife			1	1	2	1	4	3	7	8	11	2	39
Without skilled work											2	17	19
Emigrated		1	2		3	2	5	9	21	17	26	3	89
Temporarily abroad						1	1	1	5	6	19	21	54
d. Sub-Total		1	3		5	4	10	13	33	31	58	43	201
e. Dead, Retired, etc.		46	38		31	20	14	10	12	9	8	1	187
GRAND TOTAL		51	76		146	129	187	243	394	380	571	406	2,583

TABLE XIII

EMPLOYMENT DISTRIBUTION OF CAND. REAL. GRADUATES (1907-66) IN 1967 BY FIELD

Work	Subject	Mathematics	Mechanics	Statistics	Physics	Astronomy	Geophysics	Chemistry	Geography	Geology	Botany	Zoology	Other	Total
a. <u>School Teaching</u>		106	23		312	9	18	98	306	19	170	72	5	1,138
	University of Oslo	35	4	2	98	11	5	85	20	17	25	47		349
	University of Bergen	9	1	1	35		8	27	10	9	11	20	3	134
	N.T.H.	8	2	1	2			5	1	4				23
	Other higher education	3			7			13	1	1	13	6		44
	N.T.N.F.	4		1	40	1	1	31	4	3	4	1		90
	N.A.V.F.	4	1		7	1		11	1	2	7	5		39
	N.L.V.F.						2	3				2		7
	Government research institutes	4		1	24	1	3	17	14	26	4	26		120
	Bransjeinstitutter							7						7
	Independent institutes	1			13		1	8	1		2	6		34
	Industrial research	5			19	2	3	43	4	4		3		83
b. <u>All Research</u>		73	8	6	245	16	23	250	56	66	66	118	3	930
c. <u>Other skilled work</u>		6	2		12		6	9	80	3	5	3	1	127
TOTAL a-c		185	33	6	569	25	47	357	442	88	241	193	9	2,195
	Housewife	2	1		2			12	1	1	13	7		39
	Without skilled work	9			3		2	2		2	1			19
	Emigrated	5	4	1	25	2		26	11	4	4	7		89
	Temporarily abroad	8			10	3	4	18	3	2	1	5		54
d. <u>TOTAL</u>		24	5	1	40	5	6	53	15	9	19	19		201
e. <u>Dead, Retired, etc.</u>		45	7		56	12	3	39	35	15	35	23	1	187

VII. POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM

What are the major problems facing policy-makers concerned with postgraduate education in Norway, and what policies are being considered, or could be considered, to alleviate them? These questions are the subject of this final section of the paper.

The major problem is surely a result of the lack of status of the first degree outside professional fields. Because in science cand. mag. is regarded as little more than half-way to cand. real., relatively few students are prepared to stop there. Similarly, the employment opportunities for those who do are perhaps not commensurate with the expectations of a graduate. Some find posts as high-grade technicians in industry, whilst others are employed as teachers in elementary schools. (However, official policy is now that elementary school teachers should largely be the graduates of non-university teacher training colleges rather than holders of cand. mag. This may serve to increase the numbers going on to cand. real. because it may close a major avenue of employment.) Even if it were possible to reduce the numbers who do go on to cand. real. - and it is not clear that this could easily be done given the ways in which students finance such study - it is necessary first that employment opportunities exist. Part of the problem must be with student attitudes. Graduates in Norway - as in almost all European countries - will increasingly have to realise that a degree is no longer an automatic passport to a prestigious career. Graduates in all countries will increasingly have to fill posts that have not hitherto been regarded as requiring a graduate. But this is a problem of second and not third cycle education. At the same time, it must be asked whether or not cand. real. is appropriate, or necessary, for the secondary school teacher. In no other country is a degree at this level required for a career of that kind. This problem is widely recognised in Norway, and a substantial body of opinion considers that cand. real. represents "too much" education. It seems less the question of cost than of duration of studies which backs up this opinion in Norway - cand. real. graduates will typically be 28 years old on first employment. Equally, there are those who consider that some understanding of research is of inestimable value to all who are able to obtain it and who would hesitate to agree to drastic cuts in the numbers receiving such education. [An important question in this context is the effect of any reductions upon the performance of university research. To what extent is university research dependent upon the work of students? This question was raised in section IV(d), where it was concluded that dependence was less than in many other countries.] A policy which is much favoured is that cand. real. should be somewhat reduced in level - perhaps being retained as a prerequisite for teaching - with the introduction of a Ph.D. degree which would be between the present cand. real. and the present Norwegian doctorate.

TABLE XIV

1967 EMPLOYMENT OF 1965-1966 CAND. REAL. GRADUATES

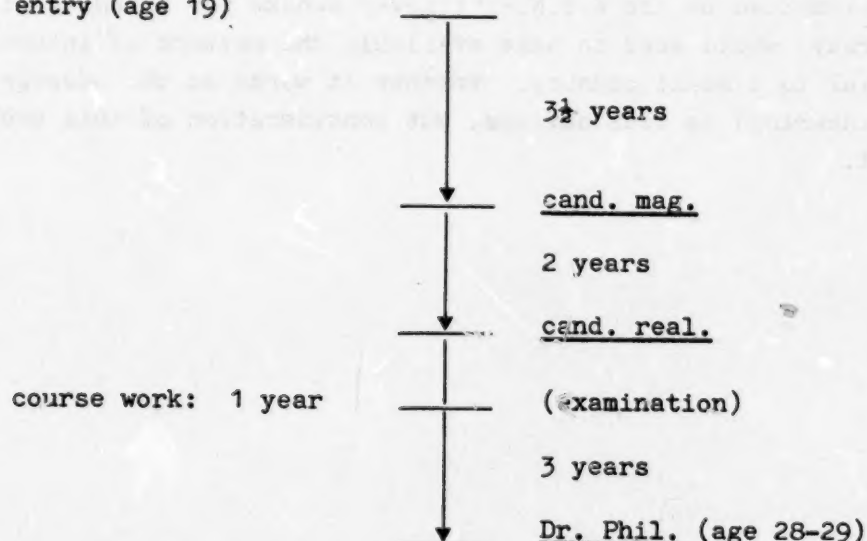
(compared with 1967 employment of total stock of cand. real. graduates)

	Schools	Research				Other skilled work	Abroad	Dead, unemployed
		Higher education	Research councils	Industry	Government and other			
1965-1966								
Graduates (%)	37.5	31.5	6	5	7	2	6	5
All (%)	44	21	5	3	6	5	6	10

This would serve to alleviate a second major problem: that of the disorganisation of doctoral study. The new research fellow, or assistant, taking up his post has generally had only about 1½ years' research experience. Yet, he receives virtually no further teaching or supervision, being left essentially to pursue a programme of research of his own, which he may not be sufficiently prepared to be able to do. It is recognised by policy-makers that professors must increasingly accept responsibility for the guidance of those beginning work in their institutes. In order that education in research should last longer than the 1½ years involved in the cand. real., and that a doctorate should be more readily attainable, the scheme set out below has been recommended by a Committee on Research of the Committee of Norwegian Universities.

PROPOSED SCHEME

entry (age 19)



This is a plausible scheme, even if it is one likely to encounter opposition from professors in non-scientific disciplines who resent the debasement of the doctorate. Student stipends could be available under existing fellowship and assistantship schemes - which are after all very comparable with schemes for the finance of doctoral education in Canada and the United States - and it would be perfectly possible for the N.A.V.F., for example, to require university institutes to take more formal responsibility for those working for the doctorate. If a system of this kind resulted in more students than at present staying on beyond cand. real. (if, for example, doctoral study could be financed by the loan scheme), there could be difficulties deriving from the lack of research opportunities. Because of the levelling off in the rate of expansion of the universities, and because of the very small demand for research personnel on the part of industry, the number of openings for Ph.D.s may not be great. If such a scheme were introduced, the numbers enrolling would have to be controlled - by control of finance, for example, though this would be difficult in a country where self-finance is not uncommon. This lack of industrial demand for scientists brings us to the third problem of postgraduate education (or, indeed, of higher education in general) in Norway. The very poor relations existing between industry and university faculties at Oslo and Bergen, in contrast to the good relations between industry and the University of Technology in Trondheim, have already

been pointed to by the Examiners for the OECD report on Norwegian science policy (1). Ways have to be found of improving these relations, and in this respect the lead taken by the N.T.N.F. is to be welcomed; this body has a crucial role to play here. However, it must be pointed out that the division of responsibility for the finance of university research projects between the N.A.V.F. and N.T.N.F. may be highly dysfunctional here. In a country of Norway's size there could be advantages attaching to all research grants deriving from one council - in engineering as in science and the humanities. The present system could be said needlessly to perpetuate the split between basic science and technology at the government level. The responsibility for research institutes could easily devolve upon a separate body from that which awarded grants; the former would still be able to contract work to universities.

Finally, there is Norway's reliance upon the "external" education of her students. At the postgraduate level this appears to work remarkably well, and when it is increasingly supplemented by the N.T.N.F.'s newer scheme for bringing high-level foreign scientists to Norway, would seem to make available the network of international contacts which are essential to a small country. Whether it works at the undergraduate level (e.g. in medicine, engineering) is less obvious; but consideration of this problem lies outside our present remit.

(1) Reviews of National Science Policy: Norway, OECD (Paris, 1970).

SOURCES OF TABLES

Table III	N.A.V.F.: Utredningsinstitutt "Rekrutteringssituasjonen ved de høyere laerestedter ..." (May 1970), mimeo'd Appendix 1.
Table IV	N.T.N.F.: "Norske Realkandidater 1963-1966" (1967). OECD: <u>Development of Higher Education 1950-1967, Statistical Survey</u> (Norway), (Paris, 1970).
Table V	Skoie: "The Problems of the Small Scientific Community - the Norwegian Case" <u>MINERVA VII</u> (3) (1969).
Table VI	N.T.N.F.: "Norske Realkandidater 1963-1966" Table 16.
Table VII	N.T.N.F.: (<u>loc. cit.</u>) Table 18.
Table VIII	Skoie: unpublished information.
Table IX	N.A.V.F.: Utredningsinstitutt (<u>loc. cit.</u>).
Table X	T. Hernes (N.T.N.F.): "Melding om N.T.N.F.s Stipendvirksomhet 1969" (mimeo'd) (February 1970).
Table XI	OECD: <u>Reviews of National Science Policy: Norway</u> (Paris, 1970), p. 159.
Table XII	N.T.N.F.: (<u>loc. cit.</u>) Table 19.
Table XIII	N.T.N.F.: (<u>loc. cit.</u>) Table 21.

BIBLIOGRAPHY

N.A.V.F.: Institute for Studies in Research and Higher Education (Utredningsinstitutt): Norwegian Students at Institutions of higher education in Norway and abroad, 1970: 1.

N.A.V.F.: Utredningsinstitutt Recruitment situation in higher educational institutions... (May 1970).

N.T.N.F.: Norwegian realkandidater 1963-1966 (December 1967).

OECD: Reviews of National Science Policy: Norway (Paris, 1970).

OECD: Development of Higher Education 1950-1967, Statistical Survey (Norway) (Paris, 1970).

UNESCO: National Science Policies in Europe - Norway (1970).

H. Skoie: "Problems of a Small Scientific Community - the Norwegian Case", MINERVA VII (3) (1960).

ANNEX E

ANNEX E

POSTGRADUATE EDUCATION IN THE UNITED KINGDOM

TABLE OF CONTENTS

	<u>Page</u>
I. <u>GROWTH AND TRANSITIONS</u>	219
II. <u>BALANCE BETWEEN RESEARCH DEGREES AND ADVANCED COURSE-WORK BY FIELD</u> ...	221
III. <u>SOURCES OF FINANCIAL SUPPORT</u>	223
(a) Science Research Council Policy.....	226
(b) The Social Science Research Council.....	226
IV. <u>THE NATURE OF THE PH.D.</u>	226
(a) History and Growth	226
(b) Transition Ratios by Field	227
(c) Content, Duration, and Success or Failure	228
(d) Contribution of Postgraduate Work to Sectoral Research Effort ...	230
(e) Unorthodox Ph.D. Schemes	231
V. <u>OTHER POSTGRADUATE WORK</u>	235
(a) Bosworth "Matching Sections"	236
(b) Joint Science-Social Science Research Council Courses	236
VI. <u>SUBSEQUENT EMPLOYMENT</u>	239
VII. <u>POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM</u>	243
SOURCES OF DATA	247
BIBLIOGRAPHY	248

I. GROWTH AND TRANSITIONS

Postgraduate work is a substantial part of the educational activity of all 49 British universities, and all new universities have, from their very inception, enrolled students for higher degrees.

Although the rate of growth is now rather slow, the percentage of the total university student population which is pursuing postgraduate courses of study has increased to about three times its value in immediately post-war years.

TABLE I
POSTGRADUATE STUDENTS AS % OF ALL ENROLLED STUDENTS
(full-time only)

<u>1938-39</u>	<u>1946-47</u>	<u>1952-53</u>	<u>1955-56</u>	<u>1960-61</u>	<u>1961-62</u>	<u>1966-67</u>	<u>1967-68</u>	<u>1968-69</u>
6.2	5.1	14.4	14.9	16.6	17.1	17.4	17.5	17.9

The 37,784 full-time postgraduates represented 17.9 per cent of the total enrolment of 211,485 in 1968-69, compared with 35,019 out of 200,121 (17.5 per cent) one year previously.

Although all universities contain postgraduate students, this percentage of total enrolments varies between institutions. Thus, in some of the very new institutions it can be as low as 10-12 per cent, whereas in the Imperial College of Science and Technology (London) and in the London School of Economics it is as high as 37.5 per cent.⁷

An important distinction has to be made between postgraduate students carrying out research - usually for a Ph.D. - and those pursuing advanced course-work, whether for an essentially vocational purpose (e.g. medical training) or of a specialist-scientific type - possibly as a preliminary to research. Both are regarded as training: the first is intended to provide a training in research. Non-research postgraduate courses have proliferated in the post-Robbins period and, in contrast to the very great attraction of research, many of these have not attracted many students. Apart from the immediate post-graduation courses some, though as yet few, shorter in-career or "post-experience" courses are offered, mainly in technological subjects. These are more common in non-university higher education.⁷

Transition Ratios

A convenient indicator of the growth of postgraduate study is the transition ratio. This is the percentage of each graduating year which goes on to further study. Its interest as an indicator inheres in (i) its being the factor upon which much government policy-making for postgraduate education is based and (ii) it may be compared with measures of a priori student preference obtained by surveys, etc., of enrolled undergraduate students. Table II gives the percentages of first degree graduates in 1968 who went on to further study of various kinds and in various disciplines, as well as a series of such percentages for science and technology students.

TABLE II
PERCENTAGES GOING ON TO POSTGRADUATE STUDY

	1962		1963		1964		1965		1966 (1)		1968		
	S	T	S	T	S	T	S	T	S	T	S	T	Soc.
Research and further academic study:													
Home	25.9	13.9	27.3	16.4	29.7	16.6	31.1	17.7	29.8	14.7	25.0	14.4	12.1
Abroad	1.8	1.5	1.9	1.6	1.8	1.3	1.8	1.4	1.4	0.9	1.5	1.1	1.7
Teacher training	16.6	1.4	17.3	1.5	17.1	2.0	14.5	1.2	14.1	1.2	13.6	1.5	12.4
Other training	4.9	0.3	4.9	0.3	4.4	0.6	4.7	0.5	4.7	0.2	5.3	1.0	11.8
Total	49.2	17.1	51.4	19.8	53.0	20.5	52.1	20.8	50.0	17.0	45.4	18.0	38.0

(1) Includes ex-Colleges of Advanced Technology.

Abbreviations

S = Science

T = Technology

Soc. = Social Sciences

It is very interesting to compare these figures with the expressed preferences of undergraduates. How many would like to stay on for further study of various kinds? Such information is available for science and technology students from a survey carried out by D. Hutchings.

TABLE III
INTENTIONS ON GRADUATING (%) /1964-65/

	<u>None</u>	<u>Ph.D.</u>	<u>Master's</u>	<u>Dip. Ed.</u>	<u>Professional Instruction</u>	<u>Other</u>
Pure science students	19	54	10	9	3	7
Technology students	15	25	12	1	59	7
All	17	42	10	6	25	7

In other words, 64 per cent of scientists and 37 per cent of technologists would have liked to stay on for further academic study and research, compared with 33 per cent and 19 per cent who did so (see Table II). The percentages going into teacher training, on the other hand, were actually twice as great as those who expressed a desire to do this. It appears that teacher training, allowing a further year at the university, is a reluctant second best to doctoral research for science students.

Table III gives some indication of the provision that might have to be made if policy were simply to respond to social demand. It is interesting to note, however, that the percentage of those expecting to do a Ph.D. decreases from the 1st year of study to the 3rd - although we have not introduced this extra dimension here.⁷

II. BALANCE BETWEEN RESEARCH DEGREES AND ADVANCED COURSE-WORK BY FIELD

In Table IV the total enrolments are shown for the major divisions of academic study divided into the two major classes of postgraduate work: research and advanced course-work. It should be pointed out that the very high course-work enrolments in education and social studies, and the high concentration of women in both of these, are to be seen in the light of the fact that these groupings cover teacher training and social work training.

TABLE IV
POSTGRADUATE ENROLMENTS 1968-69 BY FIELD AND TYPE OF WORK
(FULL-TIME STUDENTS)

	Research		Advanced Degree Courses		Other - Non-Degree		Total	
	Men	Women	Men	Women	Men	Women	Men	Women
Education	140	53	2,920	2,836	602	458	3,662	3,347
Health, Medicine	837	239	446	110	287	69	1,570	418
Engineering and Technology	3,525	61	1,769	29	152	10	5,446	100
Agriculture, Forestry and Veterinary S.C.I.	499	71	233	14	31	5	763	90
Pure Science	8,004	936	1,218	189	229	40	9,451	1,163
Social administration, Business studies and planning	2,230	492	3,009	1,275	213	42	5,452	1,809
All Arts/Humanities	2,521	965	928	451	210	67	3,659	1,483
All	17,756	2,817	10,523	4,904	1,724	691	30,003	8,412

TABLE V
BALANCE BETWEEN RESEARCH AND OTHER ADVANCED WORK
IN SCIENTIFIC DISCIPLINES
(1968-69)

	Number Doing Research for a Degree	Number Taking Course-work for a Degree	Other	Total
Biology	597	115	21	733
Mathematics	955	543	34	1,532
Physics	1,892	258	69	2,219
Chemistry	3,263	149	85	3,497
Geology	399	100	24	523
All Natural Sciences	8,940	1,407	269	10,616

The overall ratio between numbers enrolled in the advanced course-work degree in science, e.g. M.Sc., (generally one year), and in the research degree, e.g. Ph.D., was 1:6.3 compared with 1:6.7 a year previously.

This conceals the great differences existing between certain fields. In chemistry, for example, which accounts for 1/3 of all postgraduate enrolments, the ratio was 1:22; in economics it was about 1:1. Note also that women research students are twice as common in the biological as in other sciences (20 per cent cf. 10 per cent).

III. SOURCES OF FINANCIAL SUPPORT

Comprehensive data are available on the sources of financial support of students in science and technology.

TABLE VI	
No. OF STUDENTS RECEIVING SUPPORT (1966-67)	
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20
21	22
23	24
25	26
27	28
29	30
31	32
33	34
35	36
37	38
39	40
41	42
43	44
45	46
47	48
49	50
51	52
53	54
55	56
57	58
59	60
61	62
63	64
65	66
67	68
69	70
71	72
73	74
75	76
77	78
79	80
81	82
83	84
85	86
87	88
89	90
91	92
93	94
95	96
97	98
99	100

Subject - Activity	U.K. students								Over-seas Students	Total
	Research Councils			Univer-sity	Indus-try	Self	Other			
	Science Research Council	Other	Total							
Science - research	3,480	607	4,087	892	684	643	171	533	1,480	8,490
Science - courses	496	62	558	29	137	81	84	59	406	1,354
Technology - research	1,015	29	1,044	321	364	516	46	160	984	3,435
Technology - courses	341	9	350	89	230	214	123	45	711	1,762

In Table VII the distribution of support is compared, in percentage terms, for British students pursuing research degree work in 1958-59 and 1968-69.

TABLE VII
BRITISH SCIENCE AND ENGINEERING RESEARCH STUDENTS
SUPPORTED BY DIFFERENT BODIES (%)

Academic year	Research Councils			Industry	Other	Total
	D.S.I.R.(1)/ S.R.C.	Other	Total			
1958-59	39.2	6.0	45.2	14.5	40.3	100
1968-69	48.1	8.3	56.4	10.8	32.8	100

The most important source of support is the Science Research Council, which now supports almost half of all British research students in science and engineering, and

BRITISH COURSE-WORK STUDENTS

1968-69	40.0	3.7	43.7	11.3	45.0	100
---------	------	-----	------	------	------	-----

over 40 per cent of those reading for master's degrees, etc., in science and engineering. Other government agencies, including local government authorities, support half as many. Since the provision of student support grants is one of the major means at the disposal of government for controlling the growth of postgraduate education, it is important to consider S.R.C. policy in more detail. It is also a possibility worthy of discussion that control of research enrolments is only really possible to the extent that students are dependent upon government support. For example, there is evidence that at the moment many of those who fail to obtain a grant from the S.R.C. are able to obtain it elsewhere: "Returns collected by the S.R.C. show that in the last two years(2) (when the number of awards sought has grown more rapidly than awards offered) a high proportion - at least two thirds - of candidates eligible for research awards who failed to obtain support from the Council nevertheless managed to stay on at university to undertake research training".

[Of course, the possibility of obtaining funds, e.g. from industry, varies greatly between fields, being high in technology and chemistry and much lower in biology and non-scientific fields.]

In other words, there is a certain inelasticity between the number of student-ships offered and the number of students staying on for further study.

(1) The predecessor of the Science Research Council (S.R.C.).

(2) 1964-66 (Swann Report p. 19).

(a) Science Research Council Policy

S.R.C. policy for some years has been to offer awards to a pre-determined percentage of new graduates. For some years this percentage was 18 (of all first degree graduates in science/applied science), but in 1968-69 the percentage was reduced to 16. Council policy up to 1970 has been to maintain this percentage. It must be pointed out, however, that since 1957 this total support has included grants for students taking certain postgraduate courses (e.g. M.Sc.) as well as doing research for the Ph.D. The percentage of these grants given to research students has always been very high, but current policy is to reduce it, offering relatively greater support to course students.

The system by which they are allocated - quotas for departments and a subsequent "pool" - is of interest here. Ninety per cent of studentships are allocated between departments, which then choose to whom these should go. Departments apply to the Council for a quota and are given a number of awards, depending upon how many students wish to go there to do research. The other 10 per cent of grants are allocated later in a pool, for which any department may nominate a student who did not receive a quota award.

(b) The Social Science Research Council (S.S.R.C.)

Government support for students either doing research or taking approved advanced courses in social science fields is being increasingly concentrated in the S.S.R.C. (Report, p. 30). In 1968 S.S.R.C. funded 901 new studentships covering social sciences and some subjects bordering the arts or humanities (e.g. economic and social history); this is about 9 per cent of the total social science graduation, or 40-50 per cent of those graduating with good degrees in the requisite subjects. Of these, 57 per cent were for two years (1) and the remainder for one year - this must be roughly equivalent to the breakdown between research and course-work (N.B. S.S.R.C. does not cover the cost of teacher or social work training.)

The Council estimated that some 30 per cent of all new award holders come from outside the social sciences, although they give no indication of where they come from or how.

IV. THE NATURE OF THE PH.D.

(a) History and Growth

Conscious Government concern with the establishment of a research degree may be dated from about 1916, when a committee under the physicist Sir J.J. Thomson recommended the introduction of research studentships in the sciences to ensure a provision of trained research workers. The Ph.D. was by then gradually becoming known, having appeared in British universities partly to balance the pre-war attraction of German and the post-war attraction of American universities in which the status conferring doctorate could be gained. The D.S.I.R. awarded research studentships almost from its inception. About 100-200 such awards were made annually in the 1920s, rather less in the 1930s and a very much larger, and increasing, number since the war: 106 in 1945, 382 in 1950, 942 in 1960. Expenditure by the D.S.I.R. on this, which had been £212,000 in 1949-50, had risen to £904,000 in 1959-60. D.S.I.R.'s successor, the S.R.C., spent over £5 million on this alone in 1968-69.

(1) Until 1971, these were generally extendable for a third year.

(b) Transition Ratios by Field

In order to understand current concern over the nature of the Ph.D., it is useful to consider transition ratios in greater detail than was done in section I. We shall restrict ourselves here to the basic sciences, and consider flows into research training only. Section I indicated that, in 1967, 28.6 per cent of pure science graduates went on to some form of further education, and also that a rather higher proportion would have wished to.

TABLE VIII

PERCENTAGES GOING ON TO DO RESEARCH (1) (1966)

Discipline	Estimated Percentage of Graduates going on to do Research
Biological sciences	23
Biochemistry	47
Mathematics	16
Physics	31
Chemistry	39
Geology/Environmental sciences	31
Other sciences and combination of sciences	10
Overall	26

(1) This percentage is not given in statistics. We have estimated it by multiplying the percentage going on to further academic study and research in 1966 by the percentage of those enrolled for higher degrees (1967-68) doing research in each discipline.

These figures can be compared with the 54 per cent of pure science students who appear to wish to go on to do a Ph.D. Clearly, the actual proportions must depend initially upon this desire - which does seem to follow fairly generally upon an English education - as well as upon practicability. The latter, of course, will depend upon first being accepted for a place and secondly upon receiving a grant. It does appear, however, that the vast majority of those accepted for postgraduate research work are able to obtain funds from somewhere.

Two interesting facts to appear from the study by Hutchings (loc. cit.) are:

- (i) students on the whole have no idea of precisely what research they are going to do: Hutchings found that only 2.5 per cent of those who definitely intended to do research had any idea of what they would do;
- (ii) only about 23 per cent contemplated working in a field other than that in which they would qualify. (Hatch and Rudd's study showed that this was subsequently borne out in practice: about the same percentage did change field.)

How can we explain the differences between the above figures in terms of differential attraction to research or differential practicability?

Hutchings's study breaks down the undergraduate preferences by the four disciplines he considered:

	Hutchings (preferences)	Transition ratios	Possibility
Mathematics	35	16	$\frac{2}{3}:1$
Physics	63	31	$\frac{2}{3}:1$
Chemistry	59	39	$\frac{3}{2}:2$
Zoology	47	(Biology) 23	$\frac{2}{3}:1$

Thus, it appears that there are differences in the extent to which students in different fields wish to do research [equivalent figures for applied science students are rather lower]. Given the initial desire, the likelihood of a student who wants to do research being able to do so seems to be constant between disciplines, except that it appears to be higher in chemistry. This might be a consequence of the large overall research effort in chemistry and the greater possibility of obtaining an industrial support grant in that subject. With this exception, therefore, it can be said that the transition ratios mirror student preferences, but with the application of a uniform constraint (the need to obtain support, primarily).

(c) Content, Duration, and Success or Failure

The English Ph.D. is traditionally a purely research degree. Although some universities have required potential Ph.D. students to pass an examination after initial registration, the practice has been limited to a few fields and a few universities. It is only relatively recently that compulsory course-work, whether or not combined with an examination, has begun to make in-roads into the traditional system. At the present moment the situation differs from discipline to discipline within science.

	% of Departments in which Course-work is Compulsory	% of Departments in which Course-work is Examined
Chemistry	65-70	60
Physics	75	45-80 (unclear)
Biology	10	5-10

A Royal Society panel on postgraduate physics education suggests that the introduction of compulsory course-work (which is most widespread in physics, especially theoretical physics) is due to the increasing specialisation of the subject. The Ph.D. developed at a time when it was possible for an undergraduate to acquire virtually all the basic knowledge his career would demand, and then to be able to guide himself through his research via the literature. Thus in physics - particularly in experimental physics - course-work is intended to assist specialisation. The Royal Society panel on chemistry, however, found that course-work may be used either to contribute to specialisation or to broaden in a period of great specialisation. In biology it is relatively uncommon and departmental opinion as to its value is divided, although no one seemed to want to use it as the basis of examinations. Many would wish biology research students to acquire

mathematics or statistics at this level. It may be that the shortage of Ph.D. instruction is due to the generally small size of biology departments and the small numbers of students doing research in each. It may not be practicable to lay on courses, either because of lack of competence in the department, or lack of demand, in such cases; and co-operation between departments may be the best means of providing adequate instruction.

Discounting those who do the necessary research by part-time study, the average duration of a successful Ph.D. is slightly over three years, of which, in many subjects, the first is likely to be increasingly taken up by course-work. The survey by Rudd and Hatch compares the duration for various disciplines, and some of their data are reproduced here, although differences probably mean very little.

TABLE IX
AVERAGE DURATION OF A SUCCESSFUL Ph.D. BY DISCIPLINE

Discipline	Mean Time Taken In Months: Full-Time Successful Candidates
Biology	41.8
Biochemistry	39.7
Chemistry	38.3
Mathematics	36.6
Physics	41.7
Geography	45.2
Psychology	42.6
Sociology, Economics, other Social Sciences	34.0

Wastage in graduate studies is hard to define. Because there is frequently no limit to the time which may be spent in doing a Ph.D., one can only introduce an arbitrary cut-off point and say that anyone who has not received his degree by that time is unlikely to do so. This is the method which Rudd and Hatch employ. They also class as unsuccessful those whose thesis was thought to merit a master's degree but not the doctor's degree for which it had been submitted.

TABLE X
Ph.D.: SUCCESS AND FAILURE

Faculty	Successful (%)	Unsuccessful (%)	Total No.
Arts	50	50	119
Social studies	60	40	80
Science	85	15	761
Technology	77	23	220
Other	69	31	62
TOTAL	78	22	988

Basically, the success rate is much higher, and therefore wastage is lower, in scientific subjects than in arts or social sciences. An important predicate of failure seems to be pursuit of a degree by part-time study, and some of the differences between faculties can be explained on the grounds that many more arts students than science students do part-time Ph.D.s. (See Table XI.) However, it appears that class (grade) of first degree is not correlated with success at postgraduate work. This accords with Hudson's finding that many eminent British scientists have relatively undistinguished first degrees (1). Those who have changed their place of study, or their subject, also seem to be slightly less successful.

TABLE XI

Ph.D.: SUCCESS AND FAILURE BY FULL- AND PART-TIME STUDY

Faculty		Successful (%)	Unsuccessful (%)
Arts	full-time	63	37
	part-time	52	48
Social studies	full-time	78	22
	part-time	58	42
Science	full-time	91	9
	part-time	69	31
Technology	full-time	85	15
	part-time	47	53
Other	full-time	89	11
	part-time	56	44
All	full-time	86	14
	part-time	59	41

In spite of this, there appear to be significant residual differences between faculties which are not explained.

(d) Contribution of Postgraduate Work to Sectoral Research Effort

It would be very valuable within the context of this study if some means could be found of estimating the contribution which postgraduate students make to the overall university research effort. This is hard to do. Within the social sciences and humanities, where faculty member/supervisor and his research student pursue their relatively independent courses of research, it would entail an impossible judgement of quality. In science, where student and supervisor are more likely to be working together on a project, a similar value-judgement is desirable but equally difficult. To some extent, however, there is a division of labour here, so that the supervisor is responsible for the generation of ideas (thesis topics) and the student for their pursuit. However, given the convention that manpower comparisons divorced from quality considerations may usefully be made (as of course they are), we use the following simple approximation as methodology.

(1) L. Hudson: "Degree Class and Attainment in Scientific Research", British Journal of Psychology, 51 (1960), p. 601.

We may simply compare the man-hours of research put in by students with the number put in by faculty members.

Unfortunately, a complete breakdown of faculty members by discipline is not available, therefore this approximation can only be made for broad subject groups. This is done in Table XII, below, on the basis of 1/3 of faculty time, 2/3 of research staff time, and 2/3 of research student time.

TABLE XII

RELATIVE CONTRIBUTIONS TO RESEARCH EFFORT (1966)

(Men x Time)				
	Contribution of Full Faculty (1)	Contribution of Research Staff (2)	Contribution of Research Students (3)	% (3) of Total (1 + 2 + 3)
Physical sciences	1,480	700	4,200	66%
Biological sciences	460	290	1,460	66%
Engineering/Technology	1,350	520	2,290	55%

The final column is an estimation, purely in manpower terms, of the percentage of all university research done by postgraduate students, for each subject group. Clearly, the effort is a very significant part of the total, and any new policy seeking in any way to reduce research student enrolments must take account of this contribution.

(e) Unorthodox Ph.D. Schemes

Although the vast majority of doctoral degrees are obtained as a result of 3-5 years' full-time study and research within a university, the exceptions to this rule are of growing interest and importance.

(i) The Council for National Academic Awards (C.N.A.A.)

The C.N.A.A. is a self-governing body established by the Government in September 1964. The Council has powers granted by its Charter to award degrees, comparable in standard with those granted by universities, to students who complete approved courses of study or research in establishments which do not have the power to award their own degrees. The C.N.A.A. has always had the power to award higher degrees: M.A. and M.Sc. for pursuit of an approved course of study, M.Phil. and D.Phil. for a programme of research work.

"The programme of work may be concerned with pure research or any aspect of industrial, commercial or professional activity, such as research, development, design, production, market investigation, etc. The candidate must receive training in the basic methods of research, design, etc., and should normally take appropriate courses of postgraduate study.

"The Council believes that research work leading to its degrees should encourage links between colleges and industry, commerce, and other appropriate fields of professional activity. If such a link is appropriate to the candidate's work he should, normally, have 2 supervisors, one from a college and one from industry,

commerce, or other professional field; one supervisor, preferably a member of the college staff, being the candidate's director of studies." (1)

Thus, candidates may be principally based either in a non-university higher education institution (e.g. one of the 27 polytechnics now in existence or another further education college), or in a research institute or industry. Table XIII shows that nearly 90 per cent are college-based. Almost all the 639 registered candidates are working for degrees in pure sciences and engineering, compared with 412 a year previously. Sixty D.Phils. were awarded between October 1968 and December 1969.

The C.N.A.A. has made it far more possible for research workers in industry and government who lack a higher degree to obtain one. Of course for them to take advantage of this possibility the co-operation and encouragement of employer-organisations is necessary.

(ii) In Government laboratories

A survey of Government research establishments carried out by the Sutherland Committee (1966) indicated that some 10 per cent of all scientific staff with a Ph.D. had obtained the degree whilst working in the Government service. Disproportionally large numbers among these were earned by employees of the Medical Research Council (M.R.C.) and the Agricultural Research Council (A.R.C.), many of whose institutes have close "special relationships" with individual universities. The Committee estimated that 11 higher degrees were given annually to M.R.C. employees, 25 to A.R.C. employees, and 12 to those from other institutions.

Fifty per cent of all external degrees are awarded by the University of London, which has for many years allowed holders of its own first degrees to register as research students and submit work for an external London Ph.D. without formal supervision. Many universities award higher degrees to external candidates, often making special arrangements for employees of certain institutions with which they have close links, whether governmental or industrial establishments. Details of such schemes are summarised in Figure I.

The Sutherland Committee was most anxious to see an increase in the number of arrangements between government laboratories and individual universities permitting laboratory staff to work for higher degrees. The Committee wrote (§ 208):

"Accordingly we recommend that Universities give careful consideration to the liberalisation and codification of their rules for higher degrees when the research work is carried on outside the University. It is very desirable that the resulting regulations should not differ too widely."

Of course, for this Committee, such relationships were part of the general problem of university-research institute links; their perspective was not a primarily educational one.

(iii) In industrial laboratories

It is perhaps less easy for an industrial employee to register for a higher degree than for a government employee. A recent report of a joint committee of the Committee of Vice-Chancellors and Principals and the Confederation of British Industry has

(1) C.N.A.A.: Statement No. 4 "Conditions for the Award of Higher Degrees" (London, 1966), p. 10.

TABLE XIII

**CANDIDATES REGISTERED FOR THE C.N.A.A.'s
RESEARCH DEGREES OF M.Phil. AND Ph.D.
AS AT 31st DECEMBER, 1969**

Field of work	Location of Candidates		Total
	Colleges	Research and Industrial Establishments	
Aeronautical Engineering	2	-	2
Architecture	1	-	1
Biological sciences	38	44	82
Chemistry	180	15	195
Civil Engineering	17	1	18
Economic History	1	-	1
Electrical Engineering	39	8	47
English	1	-	1
Geography	2	-	2
Geology	4	-	4
Instrumentation and Control Engineering	5	-	5
Languages	4	-	4
Legal studies	4	-	4
Materials science	2	1	3
Mathematics/Computer science	19	-	19
Mechanical Engineering	56	2	58
Metallurgy	52	5	57
Nautical studies	1	-	1
Naval Architecture	1	-	1
Pharmacy	38	5	43
Photography	1	-	1
Photographic Technology	2	-	2
Physics	66	15	81
Printing	1	1	2
Psychology	3	-	3
Town Planning	2	-	2
TOTALS:	542	97	639

FIGURE I

**Universities Permitting Establishment Staff
to Study for Higher Degrees**

(a) Ph.D.'s with university residence of more than 12 months	(b) Ph.D.'s with residence between one term and one year	(c) Ph.D.'s with lesser attendance (e.g. one day per week) or with no formal residence requirements	(d) As in (c) but arrangements limited to master's degree
j Birmingham 2 yrs. Bristol 2 yrs. Cambridge 2 yrs. j Exeter 2 yrs. j Liverpool 2 yrs.	p Bath (n.s.) Belfast 1 yr. * Bristol 1 yr. * Cambridge 1 yr. j City 1 yr. j Durham 1 yr. j Essex 1 yr. *j Exeter 1 yr. js Glasgow 1 yr. Heriot-Watt (n.s.) j Keele (n.s.) jl Leeds 1 yr. j Newcastle 1 yr. j Nottingham 1 yr. j Oxford 1 yr. j Salford R.C.A.T. (n.s.) jp Southampton (n.s.) *j St. Andrews (n.s.) j Surrey 6 mths.	js Aberdeen jp Aston in Birmingham * Belfast *p Bradford *j Brunel js East Anglia *jl Edinburgh jln for non-graduates jl Essex j Lancaster j Leicester j London js Loughborough jn Nottingham *j Oxford j Reading js Strathclyde * Surrey js Sussex jp Wales j Warwick p Welsh C.A.T. p York	* Birmingham * Bradford * Bristol *j Exeter * Leeds * Liverpool js Loughborough jn Nottingham *j Manchester (including I.S.T.) * Sheffield * Wales

Note: Universities permitting Ph.D.'s to A.R.C. or M.R.C. unit staff are excluded. Arrangements whereby London, Cambridge and Hull allow external Ph.D.'s to their own graduates are excluded.

Because the regulations are often complex, a system of prefix codes is adopted:

* arrangements limited to graduates of the university only. This often reflects a general right of graduates of that university, irrespective of their place of employment.

s arrangements limited to specific institutions only.

n arrangements limited to nearby laboratories or to local residents.

l a longer period of qualification required if non-resident.

j some supervision by the university specifically mentioned (it is believed that a similar requirement is made by some universities for which a j is not shown).

p arrangements mentioned are at present merely proposals.

A university may have a double entry. Thus, Bristol allows its own graduates to work for a Ph.D. in an establishment with only one year's residence, while other graduates must have two years' residence. Bristol therefore appears in column (a) and also as *Bristol in column (b).

provided information on the number of firms allowing employees to attend courses at universities as part of higher degree requirements (1). Over 20 per cent of firms surveyed - covering the whole range of British industry - allowed this. Just under 1,000 employees in all were released for work at universities in order to obtain higher degrees, compared with nearly 3,000 working for first degrees. Of this 1,000, about 150 were from the chemical and petroleum industry. These statistics would not include numbers working for C.N.A.A. degrees principally in industrial laboratories.

Co-operative Awards for Pure Science (C.A.P.S.)

These are for the maintenance of students in pure science departments working on projects devised jointly by a member of the department and an industrial research leader. In 1968-69, 130 of the awards were made, in response to twice as many applications. Chemistry - in which university-industry links are particularly good - was the main beneficiary: 73 awards in response to 180 applications. In 1969, 180 awards were made, of which 155 were taken up.

Award Scheme for Science, Industry, or School Teaching (A.S.S.I.S.T.)

These grants are awarded to students on graduation but are to be taken up years later, the intervening time being spent in industry or school teaching. Two hundred and eighty-nine of these "promises" were made during 1968, and 332 in 1969. In the first 3 years of the scheme about 27 per cent of awards promised were taken up.

The University of Sussex has recently introduced a scheme whereby the doctorate can be awarded for a combination of research in chemistry and teacher training. This is a private initiative to encourage a higher proportion of science Ph.D.s to go into secondary school teaching. It is too soon to comment upon the success of the scheme.

V. OTHER POSTGRADUATE WORK

The balance between advanced courses and research training in the United Kingdom is regarded as inappropriate. It is the policy of the research councils, for example, to try to encourage more students to take advanced courses in preference to doctoral training.

The diversity of non-research postgraduate work is so great that a summary description would be a task of outrageous proportions. The Social Science Research Council alone has approved 300 courses for studentships in its range of subjects, after a review of all relevant courses offered. Of these, 200 were accorded a mark of special approval in that the courses are allocated a quota of student grants, the other 100 are eligible only at the pool stage (see section III).

This heading would, of course, include three major types of vocational training: teacher training, medical training, social work training. At the present moment, the first of these is not a necessary prerequisite for the graduate who wishes to teach. However it will soon be the case that all graduates will have to have taken an approved course of professional education training before being able to teach. This will not imply a very great expansion so far as scientists are concerned, for 75-80 per cent of

(1) Committee of Vice-Chancellors/Confederation of British Industry: Industry, Science and Universities, Docksey Report (London, 1970).

science graduates going into teaching already do possess this diploma. Equivalent figures for social sciences and the arts also lie within this range.

Medical education has been the subject of a major review, and it would not be possible to describe the whole situation in a small space. In 1953, a year of postgraduate intern practical training was made compulsory. The Royal Commission on Medical Education wished to extend this to include more, but differing, types (dependent on the doctor's choice of career) of continuing education. Note that the Commission saw the undergraduate degree - which does include a 2-3 year clinical course - as primarily:

"to educate the student to university degree standard both in the medical sciences and in the application of these sciences to human diseases".

In other words, in the view of this Royal Commission it is only at the postgraduate stage that the vocational training element is introduced.

One consequence has been that a Central Council for Postgraduate Medical Education has recently been established by the Department of Health and Social Security to exercise broad supervision over postgraduate medical education.

Among new developments, two are especially worthy of note as being particularly representative of the kind of thing at which current policy is aiming.

(a) Bosworth "Matching Sections"

A Committee under Mr. G.S. Bosworth (then Director of Personnel at the English Electric Co. Ltd., now Director of Newcastle Polytechnic) reported in 1966 on "the requirements of industry for the education and training of engineers at the graduate level". It was concerned with how the gap between an academic first degree and the very practical needs of engineering industries might be bridged. The Committee's recommendation was of a 1-2 year course, designed jointly by a university and industry and occupying the students initial period in industry. Parts of the course would be set in a company and parts in a university - the latter including notably the special technology courses. Figure II shows the design of such a scheme. The main elements of the scheme are:

- (i) a course in the principles of manufacturing engineering;
- (ii) a design and manufacturing group project - a microcosm of the industrial situation;
- (iii) a specialised course in product or manufacturing technology;
- (iv) industrial experience - organised exposure to the industrial environment.

Up to date, five such specialised technology courses have been mounted and two more are in preparation.

The Industrial Training Boards (I.T.B.'s) which have been established, one for each industry, will have an important role in the design of in-career courses of comparable kinds.

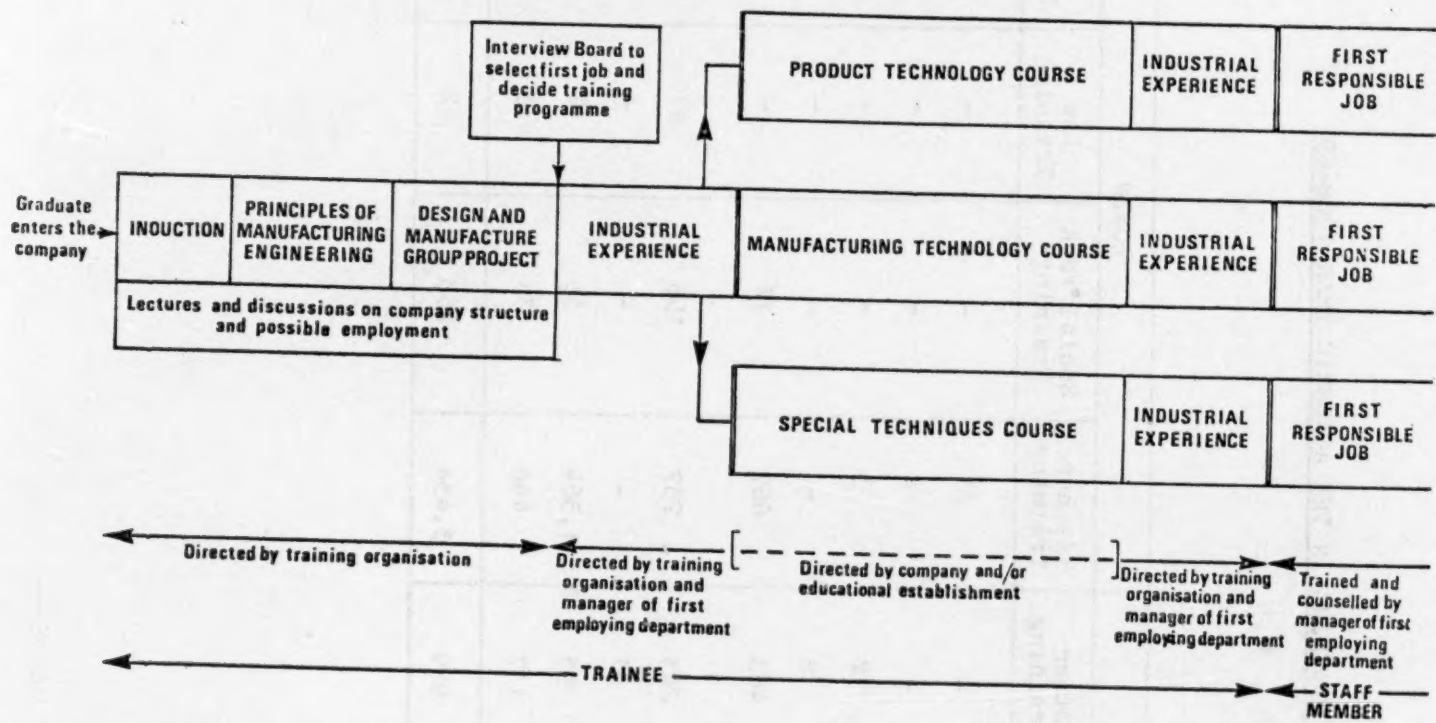
(b) Joint Science-Social Science Research Council Courses

These Research Councils, believing that courses embracing science or technology and social sciences (economics, sociology) would become of increasing importance, have established a joint committee to which a certain number of studentships have been allocated. The Councils are anxious to stimulate the initiation of courses falling within this field.

FIGURE II

DESIGN FOR A MATCHING SECTION OF EDUCATION AND TRAINING

FOR THE UNIVERSITY GRADUATE ENTERING ELECTRICAL OR MECHANICAL MANUFACTURING INDUSTRY ON GRADUATION



NOTES

1. General

Duration will vary with industrial sector, but should be flexible and minimal for stated objectives; probably between 1 and 2 years overall. Selective participation or entry at a later stage may be desirable for some trainees. Continuous pressure essential; persistent themes of time and cost throughout.

2. Induction

May vary from few days to several weeks; could be distributed over first few months. To be given in the firm or, for smaller companies collectively at an educational establishment. Includes information:

- for the trainee (conditions of employment, opportunities, training programme);
- about the Company (history, establishment, products, policy);
- about the economic environment (relations with other companies, labour, Trade Associations, Research Associations, Central Government).

3. Principles of Manufacturing Engineering

12 weeks; might be reduced or omitted for some graduates e.g. Dip.Techs. Principles and skill appreciation, *not* workshop practice or skill acquisition; college- or industry-based.

4. Design and Manufacture Project

About 12 weeks; 3-12 graduates, with or without craftsmen and/or technicians; whole cycle of ideas into hardware in industrial microcosm; under pressures of time and money. College- or industry-based but realism essential. Smaller firms may require special arrangements e.g. by grouping.

5. Specialised Technology Courses

These courses are to give instruction in all aspects of the product; marketing, design, manufacture, organisation and management. Also to reinforce basic scientific knowledge where necessary and to teach industrial "know how". Alternatively to teach all aspects and applications of special techniques for functions

covering all products, e.g. production technology, research. Maximum 9 months, possibly less; may be subdivided—possibly between initial general material and later specialised, as offering facility for selective participation or partial overlap of courses. To be devised and mounted jointly, by an educational establishment and one or more industrial units; to meet national requirements by optimum deployment of industrial and educational resources; may be mounted at one or more Centres.

(i) Product Technology Courses

Oriented towards a product—e.g. transformers, semiconductor devices; instruction to cover main functions, as well as elements of organisation, measurement and control of technical and manufacturing activities.

(ii) Manufacturing Technology Courses

(Production Engineering) Oriented towards techniques of production—manufacturing processes, materials and methods of manipulation, organisation and behaviour of systems, their control

and measurement of their properties. May relate to specific product sectors, with some overlap with product technology courses.

(iii) Special Techniques Courses

Oriented towards advanced studies for specialised activities, probably in research and development e.g. high vacuum techniques, lubrication engineering; one or more short courses may be required.

6. Industrial Experience

To learn about structure and operation of the firm and of departments; and how a complex and imperfect enterprise achieves objectives; scaling-up of knowledge and abilities acquired in more idealised and controlled environment. Must be purposive effectively organised; graduate should realise this, and have responsibility and objective.

TABLE XIV

NUMBERS COMMENCING VARIOUS FORMS OF POSTGRADUATE TRAINING IN THE ACADEMIC YEAR 1968-69

(1968-1969)

Field of Graduation	MEN				WOMEN			
	Teacher Training	Social Work Training	Law Training	Other Training	Teacher Training	Social Work Training	Law Training	Other Training
Education	17	-	-	-	23	-	-	-
Health (not Medicine)	2	-	10	-	2	-	-	8
Engineering/Technology	60	-	1	12	3	-	-	-
Agriculture/Forestry	14	-	-	8	-	-	-	3
Science	992	4	2	483	867	12	-	129
Social/Administrative studies	691	28	531	243	737	155	87	216
Architecture	-	-	-	31	-	-	-	1
Languages	647	8	7	55	1,364	55	2	479
Other Arts	371	3	8	117	440	31	3	123
TOTAL	2,794	43	549	959	3,454	253	92	959

The number of postgraduate courses offered, particularly in the sciences and technology, has increased very greatly in the post-Robbins (1963) period. With the exception of the three important types of vocational course mentioned in V above, the courses have not been well patronised, in spite of the availability of grants, and research has of course continued to exercise a disproportionate attraction. A survey of such courses for engineers and technologists carried out in 1964-65 showed that there were 264 instructional courses offered by university engineering departments and that the average number of students participating was seven. About 40 per cent of the courses had 4 or less students on them. Moreover, 45 per cent of all students enrolled on the courses were from overseas. By recognition of courses as eligible for student grants the Research Councils have sought to control this proliferation and ensure enrolments of reasonable size. The Bosworth Report (*loc. supra.*) was one attempt at improving the relevance of such training to industrial needs.

VI. SUBSEQUENT EMPLOYMENT

In Table XV below details are given of the employment first taken up by recipients of higher degrees. The category "academic research" does not include those who obtained permanent academic jobs: for scientists it is largely postdoctoral fellowships and doctoral study (groups (1) and (2) respectively). It might more properly be called "further study". Clearly, further study follows far more commonly on a scientific higher degree than on one in the arts or social sciences. Thus, whilst 23 per cent of newly graduating Ph.D.s in pure science went on to postdoctoral fellowships (55 per cent of them abroad), only 4 per cent of those in the arts and social sciences did so.

There is no evidence for true unemployment of new Ph.D.s. Out of 4,445 Ph.D.s awarded between October 1968 and October 1969, only 47 were still actively seeking permanent employment in December 1969: that is, only 1 per cent. There does, however, appear to be non-statistical evidence that many new Ph.D.s are finding it harder to obtain employment of the kind they want.

A further breakdown of that part of the category "gained employment" which refers to employment in the United Kingdom is available. In Table XVI below we aggregate doctorates with other higher degrees and look at the sector of employment entered by those who took jobs in the United Kingdom.

A matter of major concern in the United Kingdom has been the lack of people with very good qualifications - particularly in the sciences - going into teaching. Thus, whereas 80 per cent of those going into secondary or elementary school teaching at the 1st degree level in arts subjects had a 1st or 2nd class honours degree (1), this was true of only 60 per cent of scientists (1968-69). At the doctoral level, only 11 arts Ph.D.s out of 500 entered teaching and 33 science graduates out of 2,600 (2), in 1968-69.

The percentage of all those who graduated with some higher degree in pure science in 1969 who stayed in the university system - either on the faculty or for further study - was 34 per cent. The less rapid growth of universities compared with about five years ago has resulted in a smaller percentage going directly into university employment (10 per cent of scientists compared with 23 per cent in 1966, 25 per cent in 1965, 19 per cent in 1963). The percentage remaining in the university for further study, though not strictly

(1) England and Wales only, including direct entry and entry to teacher training.

(2) Great Britain.

TABLE XV
OVERALL SITUATION: FIRST DESTINATIONS OF HIGHER DEGREE GRADUATES (1968-69)
(numbers)

		Academic Study or Research (Home or Abroad)	Teacher and Other Training	Overseas Students Returning Home	Already in Employ- ment	Gained Employ- ment (Home or Abroad)	Seeking Employ- ment	Total*
1. Doctorates								
Arts -	Men	23	0	101	76	183	5	442
	Women	3	0	16	7	31	2	76
Social studies -	Men	14	1	89	55	125	1	325
	Women	6	0	8	11	15	3	54
Pure science -	Men	583	13	271	190	1,120	26	2,379
	Women	51	2	26	31	93	3	229
Applied science -	Men	76	1	198	106	484	7	925
	Women	1	0	1	1	9	0	15
2. Other degrees								
Arts -	Men	102	15	113	234	283	18	876
	Women	40	12	42	36	116	21	335
Social studies -	Men	186	17	200	136	426	27	1,173
	Women	30	5	25	19	95	12	223
Pure science -	Men	342	28	122	225	475	20	1,337
	Women	35	5	13	31	73	5	185
Applied science -	Men	250	1	260	302	568	12	1,514
	Women	1	0	5	3	20	1	39

* Includes "unknown".

employed in a permanent post, has fluctuated also as a result of university growth, being 24 per cent of scientists, as against 30 per cent in 1968, 12 per cent in 1966, 10 per cent in 1964, and 21 per cent in 1963.

In Table XVII the percentages are compared for individual disciplines, within the category pure science, for higher degree graduates in 1966 and 1969.

Thus, in all scientific disciplines, and especially in chemistry, biochemistry and physics, there has been a very sharp and continuous fall in the percentage taking university employment. At the same time, a very much larger proportion has stayed on or has moved to universities abroad for further study. [Although in actual fact this percentage was higher in 1968 than 1969, 30 per cent of all science graduates went on to further study in 1968. In other words, this trend may now have been reversed.]

TABLE XVI

OVERALL SITUATION: EMPLOYMENT CATEGORIES
(OF THOSE WHO ENTERED HOME EMPLOYMENT)

1968-69

	Civil) Armed) Local)	Service	Universities	F.E.	Schools	Industry/ Commerce	Other Including Church, Professions	Total Taking Jobs in U.K.
ALL HIGHER DEGREES								
Arts -								
Men	36		144	48	74	19	26	352
Women	7		31	23	44	1	11	117
Social studies -								
Men	51		149	57	6	168	20	451
Women	29		27	18	8	11	6	99
Pure science -								
Men	168		353	113	47	598	27	1,306
Women	30		57	12	14	28	4	145
Applied science -								
Men	101		113	50	7	575	5	851
Women	6		3	0	2	14	2	27

TABLE XVII

CONTINUANCE IN HIGHER EDUCATION SYSTEM (%)

	1966			1969		
	Further Study or Research	University Employment	Total	Further Study or Research	University Employment	Total
Biology	9.4	24.2	33.6	26	11	37
Biochemistry	7.4	34.4	41.7	37	11	48
Chemistry	14.0	16.0	30.0	31	4	35
Geological sciences	8.7	17.4	26.2	17	7	24
Mathematics	17.4	33.9	51.2	20	18	38
Physics	10.1	26.8	37.0	20	10	30
All sciences	11.8	23.0	34.8	24	10	34

It is, of course, a rather biased picture which is obtained from first employment data, so far as the overall absorption of these higher degree graduates by the economy is concerned. Doctorates and postdoctoral fellowships come to an end, and migrants return home; both have to find employment. A non-expanding university system may not be able to accommodate them. It is therefore important, though rarely possible, to look at subsequent as well as first employment. The survey by Hatch and Rudd enables this to be done for one cohort: those who started postgraduate work in 1957 and who were therefore able to benefit from the post-Robbins expansion of universities. The survey shows both changes in employment sector and changes in type of work. Excluding the fairly large movement out of employment (women, primarily), most of the inter-sectoral movements appear to balance out. Thus, there were 49 people moving from university to government, 35 from government to university. Industry was a slight loser, principally to education (university and other). So far as type of work is concerned, a large number moved from university research (i.e. post-doctoral fellowships) to university teaching. The rapid university expansion seems to have affected different disciplines in different ways. Thus, it appears that whereas the extra science staff needed came mainly from the large numbers of postdoctoral research workers, the technologists came largely from industry, and especially from industrial research. The social scientists and teachers of arts subjects were attracted from schools and non-university higher education. It also appears that of those whose first jobs were abroad, many of the scientists will have returned. Many take postdoctoral research posts and subsequently return. The converse is true of other disciplines: rather more were abroad subsequent to the first post. However, 20 per cent of science doctors were abroad in 1966.

The same survey gives a little information on a class of postgraduate student of whom we know little: those who fail to obtain their degrees. Table XVIII shows the distribution (i) by sector of employment, (ii) by type of activity for scientists who obtained doctor's degrees, master's degrees, and those who failed. It is possible, however, that this data is more of curiosity than intellectual value.

VII. POSTGRADUATE EDUCATION NOW, AND POLICIES FOR REFORM

Hatch and Rudd conclude their study by pointing out the remarkably small attraction of British industry to the science Ph.D., and the very poor image of school teaching the intake into which is highly concentrated in the academically less successful. If British thinking on science policy in the 1960s could be summarised in four principal areas of concern, these would be two of them. The other two would be the propensity on the part of science graduates to leave the United Kingdom, particularly science Ph.D.s; and the then increasing lack of interest in science on the part of those preparing to go to university. Not all of this is particularly relevant to postgraduate education, but it would be true to say that to the extent to which this paper touches on these issues, they are indeed borne out. In the course of the paper the following relevant points are made:

- (i) the tendency for graduates in science and technology to go on to postgraduate study, which was increasing rapidly to 1965, has been reversed now, though slightly;
- (ii) among those who do go on to postgraduate study, the enormous majority who do research rather than advanced course-work has been slightly reduced;

TABLE XVIII

DISTRIBUTION BY SECTOR OF EMPLOYMENT (%)

	(N =)	Government	Universities	Other Education	Industry	Other	Unemployed Not Known	Total
Doctor's	(716)	11	46	8	26	6	3	100
Master's	(95)	7	12	34	33	7	6	100
Failures	(96)	8	15	26	33	9	8	100

DISTRIBUTION BY ACTIVITY (%)

	Research	Development	Adminis- tration	Teaching	Other	Unemployed Not Known	Total
Doctor's	34	13	2	47	1	3	100
Master's	7	27	5	46	7	6	100
Failures	14	27	6	40	5	8	100

- (iii) because of the attraction of such postgraduate study, the swing against science will never result in places being more common than applicants, as is the case at the first degree level; many more would like to do scientific research than actually do;
- (iv) a very great majority of those who do postgraduate work stay in the higher education system afterwards (in the United Kingdom or abroad), even if it is hard to obtain a university post. Very few go into industry.

British higher education thus seems to be characterised by the extent to which it induces in a student the desire to study further, to do research. This is particularly true of science students though not, of course, unique to the United Kingdom. Having obtained a further degree, the students - again especially in science - are reluctant to move outside the academic world. Especially in view of the reduced rate of university growth between 1967 and 1972, British policy over the past five years or so has sought to reverse this natural spiral. Government Reports have dealt repeatedly with ways of reducing the transition ratio to research whilst encouraging the pursuit of more vocational postgraduate courses, of smoothing the adaptation between academic study and industry, of developing Ph.D. schemes nearer to the interests of industry, and so on. The University Grants Committee in advising universities on its allocation of funds for the period 1967-72 wrote:

"Many Universities will find that in their allocation letters the number of postgraduate students for which the Committee have provided is smaller than the Universities had wished. There are several reasons for this: (a) the Committee, as already mentioned, think that the flow from schools into undergraduate places should be a real priority; (b) the numerical proportion of the first degree output which embarks on postgraduate work already substantially exceeds the Robbins estimate; (c) there is uneasiness that the rise in the proportion of graduates who stay in the Universities for postgraduate studies, rather than moving into teaching or the outside world, is greater than the country can afford at present; (d) with the slackening in the rate of growth of student numbers there will be less need in most disciplines for recruitment to University staff, via a higher degree, than has been the case during the past few years."

(U.G.C., 1966)

The Government is limited, however, in what it can do; the U.G.C. does not force universities to spend their money in a particular way. One means of controlling postgraduate enrolment is by reducing the number of studentships available, but we have seen that in some disciplines many students are supported from other funds. In spite of this, figures show that the brake has at last taken hold. As regards making postgraduate work more akin to industry's needs, it is difficult to ascertain the success of this policy. Indeed, precisely what industry would like remains to be determined. Whilst some industrialists would prefer students with a specialised master's degree related to real industrial problems, others seem to like the status quo, surprising though this may seem. Though they rarely get the best people, whom they obviously want, industrialists realise that the great advantage of the highly selective system, in which postgraduate students are selected from among the best at first degree level, and in which all those who go to university are highly selected, is that the "cream sits on top of the milk", clearly visible. They know exactly whom they have to attract.⁷ Slowly, however, certain changes are likely to take place:

- (i) a decreasing proportion going on to postgraduate work;
- (ii) among these, a much reduced proportion doing research;
- (iii) increasing numbers doing higher degrees by part-time study while in industry;
- (iv) more research projects selected for industrial relevance.

It should be borne in mind, however, that any further period of university expansion, making a new flood of academic jobs available, could greatly change this process of "industrialisation". Furthermore, the future nature of non-university higher education, especially in polytechnics, is not yet clear. An increasing contribution to postgraduate work, and indeed to postgraduate research work, seems possible. If this were the case, however, the polytechnics would have started on the road towards becoming universities. This is not the wish of the Government, and in view of the rapid undergraduate-level expansion which is anticipated it may not be appropriate to encourage such a trend. Perhaps there will be a concentration of postgraduate work in universities relative to undergraduate work, or perhaps a concentration only of postgraduate research. Policies which may be developed for concentration of effort in research in restricted numbers of institutions would, of course, have important implications for Ph.D.-level work.

SOURCES OF DATA (TABLES USING PRIMARY DATA ONLY)

Table I	E. Rudd and S. Hatch: "Graduate Study and After", <u>Statistics of Education</u> , Vol. VI (H.M.S.O., 1970), p. viii.
Table II	Report of the Committee on: <u>The Flow into Employment of Scientists, Engineers and Technologists</u> . Swann Report (Cmd. 3760 H.M.S.O., 1968) Table 21, p. 126. University Grants Committee, 1970: <u>First Employment of University Graduates - 1968</u> , Tables 1 and 3. <u>First Employment of University Graduates - 1964</u> (to be published).
Table III	D. Hutchings: <u>The Science Undergraduate</u> (Oxford University Department of Education, 1967) Table 5, p. 19.
Table IV	<u>Statistics of Education, Vol. VI</u> , 1968 (Department of Education and Science, 1970), Table 14, pp. 32-3.
Table V	<u>Statistics of Education, Vol. VI</u> , 1968 (Department of Education and Science, 1970), Table 14, pp. 32-3.
Table VI	The Swann Report, Table 17, p. 119.
Table VII	The Swann Report, Table 17, p. 119. <u>D.S.I.R. Universities and Colleges</u> (Department of Scientific and Industrial Research, 1961), p. 21 S.R.C. data.
Table IX	E. Rudd and S. Hatch: <u>Graduate Study and After</u> , Table 2.11, p. 44.
Table X	E. Rudd and S. Hatch: <u>Graduate Study and After</u> , Table 2.2, p. 32.
Table XI	E. Rudd and S. Hatch: <u>Graduate Study and After</u> , Table 2.5, p. 36.
Table XIII	Council for National Academic Awards: <u>Report for 1968/1969</u> , Table F, p. 19.
Table XV	<u>First Employment of University Graduates - 1968</u> , Tables 6 and 8.
Table XVI	<u>First Employment of University Graduates - 1968</u> , Tables 7 and 9.
Table XVIII	E. Rudd and S. Hatch: <u>Graduate Study and After</u> , Tables 3.5, p. 58 and 3.6, p. 60.
Figure I	<u>Report of the Working Party on Liaison Between Universities and Government Research Establishments</u> , Sutherland Report (Cmd. 3222, 1967), p. 33.

BIBLIOGRAPHY

Published Sources

1. Council for Scientific Policy: Report of the Working Party on Liaison Between Universities and Government Research Establishments (Cmd. 3222, March 1967).
2. Royal Commission on Medical Education: Report (Cmd. 3569, April 1968).
3. Committee on Manpower Resources for Science and Technology: The Flow into Employment of Scientists, Engineers, and Technologists, Swann Report (Cmd. 3760, September 1968).
4. University Grants Committee: University Development 1962/67 (Cmd. 3820, November 1968).
5. Department of Scientific and Industrial Research: D.S.I.R. Universities and Colleges 1956/1960 (H.M.S.O., 1961).
6. Committee on Manpower Resources for Science and Technology: Education and Training Requirements for Electrical and Mechanical Manufacturing Industries (H.M.S.O., 1966).
7. Department of Education and Science: Statistics of Education: Vol. VI: Universities (H.M.S.O., 1969).
8. Science Research Council: Report for 1968/69 (H.M.S.O., 1969).
9. Social Science Research Council: Report for 1968/69 (H.M.S.O., 1969).
10. University Grants Committee: First Employment of University Graduates - 1967/68 (H.M.S.O., 1970).
11. Department of Education and Science: Science Bulletin (No. 4, 1970).
12. Council for National Academic Awards: Report for 1968/69.
13. D. Hutchings: The Science Undergraduate (Oxford University Department of Education, 1967).
14. The Royal Society: Postgraduate Training in the United Kingdom
 1. Chemistry (March 1967)
 2. Physics (February 1968)
 3. Biology (March 1968)
15. E. Rudd and S. Hatch: Graduate Study and After (Wielenfield and Nicholson, 1968).
16. Committee of Vice-Chancellors/Confederation of British Industry: Industry, Science and Universities (London, July 1970).

ANNEX F

GRADUATE EDUCATION IN THE UNITED STATES (*)

(*) We use the American term "graduate education" to refer to what in other papers is designated "postgraduate education", corresponding to English usage.

TABLE OF CONTENTS

	<u>Page</u>
I. <u>GROWTH AND TRANSITIONS</u>	251
(a) Types of Institution.....	251
(b) Institutional Transformations.....	253
(c) Concentration and Excellence.....	253
(d) Transitions.....	256
II. <u>SOURCES OF FINANCIAL SUPPORT</u>	257
Current Developments in Federal Support.....	265
III. <u>BALANCE BETWEEN RESEARCH AND COURSE-WORK, BY FIELD</u>	267
IV. <u>THE NATURE OF THE Ph.D.</u>	268
(a) The Growth of Doctoral Education.....	268
(b) Transition Ratios by Field.....	268
(c) Content, Duration, and Success or Failure.....	269
(d) Contribution of Graduate Work to Sectoral Research Effort.....	277
(e) Unorthodox Ph.D. Schemes.....	278
V. <u>OTHER GRADUATE WORK</u>	279
(a) The Master's Degree	279
(b) Professional Degrees	280
VI. <u>SUBSEQUENT EMPLOYMENT</u>	280
VII. <u>GRADUATE EDUCATION NOW, AND POLICIES FOR REFORM</u>	285
SOURCES OF TABLES	291
BIBLIOGRAPHY	292

I. GROWTH AND TRANSITIONS

The diversity and flexibility of American higher education have proved at once a source of strength and of confusion, and a stimulus to self-study. As far as the present study is concerned, the diversity of higher education institutions renders any summary account of the development of graduate study in the United States almost impossible whilst the American academic penchant for self-investigation renders it superfluous. There have been a number of learned accounts of the rise both of higher education in general and graduate education in particular (1) which have paid due regard to the cultural pluralism of American society underlying this diversity. This is not possible in a document of the present kind. There are, nevertheless, certain features of American higher education related to this multiplicity of types of institution which are essential to an undertaking of this kind. That is, the growth of American higher education is less adequately represented by the bare statistics of Table I than would be the case for any other OECD country for which comparable data were presented. We suggest that there is a bare minimum of three preliminary points which require attention:

- (i) the types of institution in terms of highest degrees awarded;
- (ii) institutional transformations (up and downgrading);
- (iii) concentration and excellence.

(a) Types of Institution

According to Consolazio (2), in the United States in 1962-63 there were 2,136 institutions of higher education. These are differentiated as follows:

2,136 post-secondary institutions	
694 junior colleges	1,442 degree-granting colleges
	1,257 accredited (3) institutions
	1,063 awarded at least one science degree
awarded at least one master's degree	700
	366 awarded at least one M.Sc. (in science)
	169 awarded at least one Ph.D. (in science)
awarded at least one Ph.D.	200

(The N.S.F. Report for 1969 gives a figure of 219 institutions awarding science Ph.D.s in that year.)

(1) e.g. R.J. Storr: The Beginnings of Graduate Education in America (Chicago, 1953).

(2) Consolazio, W.V.: The Dynamics of Academic Science (N.S.F. 67-6, 1967).

(3) "Accreditation" may be by one of a number of bodies: state, regional or national; educational or substantive. Institutions approved by one or more of these bodies are said to be accredited.

TABLE I

TRENDS IN POPULATION AND EDUCATION, 1900-1940

	Population (000,000s)		Institutions Conferring Doctorates	Academic Employees in Higher Education (000s)	Enrolments (000s)		Earned Degrees (000s)		
	U.S.	College- age (18-21)			College	Graduate	Bachelor's (and 1st-level Professional)	Master's (and 2nd level Professional)	Doctor's
1900	75.9	5.9	25	29.0	237.6	5.8	27.4	1.6	0.25
1910	92.0	7.3	32	45.0	355.2	9.4	37.2	2.1	0.44
1920	105.7	7.3	44	62.0	597.9	15.6	48.6	4.3	0.62
1930	122.8	9.0	70	105.4	1,100.7	47.3	122.5	15.0	2.30
1940	131.7	9.8	88	146.9	1,494.2	105.7	186.5	26.7	3.29

Thus we must understand that, in the first place, graduate education is concentrated in a limited number of institutions, and, in the second place, that graduate education in science is even more concentrated. Many institutions may offer graduate study in only one or two fields, and the number that offer the doctorate (again possibly in only one or two fields) represents an even more restricted elite. We can principally distinguish three classes: baccalaureate, master's and doctorate-level institutions.

(b) Institutional Transformations

The classes delineated above are not static; there exists some interchange between them, largely derived from the upgrading of colleges. For example, there is a tendency on the part of liberal arts colleges increasingly to engage in master's-level work, though these are institutions traditionally dedicated to first degree work. A recent report of the National Science Board (1) quantified these transitions. Its authors estimated that over the past century the number of doctorate-awarding institutions had increased an average of 2 per year, although more rapidly in recent years. Over the decade 1955/56-1965/66, the number of institutions offering the doctorate increased by 6.5 per annum on average, whilst an average of 2 per annum have discontinued their Ph.D. programmes. The whole picture is represented by Table II, taken from the N.S.B. report cited. Clearly, then, roughly 25 per cent of all doctorate-awarding institutions have only 10 years or less of experience of this level of work. There are very great differences in the extent of, and dedication to, doctoral-level work even within this elite group. Whilst some institutions conduct research in all major disciplines and may have a graduate enrolment of over 20 per cent of their total enrolment, others may have only one or two doctoral programmes and a graduate enrolment of only 10-12 per cent of their total (2). These differences are discussed below. It remains to be pointed out that owing to the transformations discussed above (and stimulated by Federal programmes such as the N.S.F.'s College Science Improvement Program, and Institutional Grants for Science Program), the past ten years have seen a continuing erosion of the hegemony of the "elite within an elite" discussed below.

(c) Concentration and Excellence

It has been pointed out above that institutional transitions have gradually reduced the extent of concentration of research and advanced instruction. This section will comment on the current situation, or at least that obtaining in the late 1960s. The situation is brought out in Table III. If the first three groups of institutions are considered (60 in all), it is found that although they enrol only 28.4 per cent of undergraduates, they enrol 47.6 per cent of postgraduate students; they award 30.1 per cent of science bachelor's degrees, 55.5 per cent of science master's, and 78.3 per cent of science doctorates. These same 60 institutions receive 75 per cent of all Federal funds for academic science. A different perspective may be gained from the figures giving graduate student enrolment: total enrolment for each of the seven groups of institutions. Although the average of this ratio for all institutions included is 10.8 per cent, it

(1) National Science Board: Graduate Education - Parameters for Public Policy (N.S.B. 1969).

(2) Note, for example, that whilst in the 1920s the five most productive institutions awarded about half the nation's doctorates, in the 1930s the five most productive awarded about one third, and in the 1950s the five most productive awarded well under a quarter of the total. Berelson Graduate Education in the United States (McGraw-Hill), 1960, p. 93.

TABLE II
SUMMARY OF INSTITUTIONAL TRANSITIONS
(1956-57 TO 1965-66)

Formation of Institutions			
Type	+	-	Net (+)
I	310	151	159
II	267	182	85
III	168	112	56
IV	65	20	45
			345

Frequency of Transitions			
Transition	+	-	Net (+)
O-I	298	76	222
O-II	149	45	104
II-III	119	38	81
I-II	75	10	65
III-IV	48	11	37
O-III	38	24	14
O-IV	9	4	5
II-IV	8	5	3
I-IV	0	0	0
I-III	0	2	- 2
	744	215	

Types: I: Less than 4 years
 II: Awards bachelor's and/or first professional degree
 III: Awards master's and/or second professional degree
 IV: Awards Ph.D. or equivalent

Transition to O denotes closing of institution, loss of accreditation or merger.

ranges from 22 per cent in the major institutions to only 3.3 per cent in the smallest and poorest. The correlation between extent of graduate education in science and receipt of Federal R & D funds is important; it is partly a consequence of the extent to which graduate students are supported from research grants (see section II). Similar figures are not available for other disciplines, but because proportionately less students in social sciences and humanities are supported from Federal funds the correlation will be very much less.

TABLE III

MANPOWER RESOURCES OF UNIVERSITIES AND COLLEGES ORDERED BY LEVEL OF FEDERAL FUNDS FOR ACADEMIC SCIENCE,

FISCAL YEAR 1963

(Dollars in thousands)

Level of Federal Funds for Academic Science Received by Institutions	Number of Institutions	Federal Funds for Academic Science	Educational & General Income	Enrolment		Science and Technology						
				Total	Graduate Student	R.(2)	B.A.	M.A.	Ph.D.	D.V.M.	M.D.	D.D.S.
Above \$20,000	14	\$ 394,143	\$ 715,955	295,988	65,291	0.221	13,902	6,351	2,886	175	1,240	450
Average		28,153	51,140	21,142	4,664		993	454	206	13	89	32
Per cent (1)	13	35.8	16.5	8.6	17.6		10.5	23.7	36.2	21.3	18.0	14.1
\$10,000-\$20,000	15	208,676	481,073	234,515	46,427	0.198	8,757	3,136	1,474	69	1,267	731
Average		13,912	32,072	15,634	3,095		584	209	98	5	85	49
Per cent (1)	1.4	19.0	11.0	6.9	12.6		6.6	11.7	18.6	8.3	18.5	23.0
\$5,000-\$10,000	31	223,082	701,513	440,124	64,412	0.146	17,203	5,373	1,879	164	1,811	728
Average		7,196	22,629	14,198	2,078		555	173	61	5	58	23
Per cent (1)	2.9	20.3	16.2	12.9	17.4		13.0	20.1	23.5	20.0	26.3	22.9
\$500-\$5,000	106	233,293	1,011,939	772,525	92,052	0.119	33,799	8,618	1,639	406	2,555	1,115
Average		2,201	9,547	7,288	868		319	81	15	4	24	11
Per cent (1)	10.0	21.2	23.3	22.6	24.9		25.5	32.2	20.6	49.3	37.2	35.1
\$100-\$500	129	28,881	506,162	589,829	54,425	0.092	21,672	2,250	61	9	0	157
Average		224	3,924	4,572	422		168	17	-	-	0	1
Per cent (1)	12.1	2.6	11.6	17.2	14.7		16.4	8.4	0.8	1.1	0	49
\$1-\$100	416	11,406	631,668	738,401	35,801	0.048	26,969	956	24	0	0	0
Average		27	1,518	1,775	86		65	2	-	0	0	0
Per cent (1)	39.2	1.1	14.5	21.5	9.7		20.3	3.6	0.3	0	0	0
No Federal Funds	352	0	298,083	354,074	11,556	0.033	10,134	77	0	0	0	0
Average		0	847	1,006	33		29	-	0	0	0	0
Per cent (1)	33.1	0	69	10.4	3.1		7.7	0.3	0	0	0	0
Total	1,063	\$1,099,481	\$4,346,393	3,425,456	369,964	0.108	132,436	26,761	7,963	823	6,873	3,181
Average		1,034	4,089	3,222	348		125	25	7	1	6	3
Per cent (1)	100.0	100.0	100.0	100.0	100.0		100.0	100.0	100.0	100.0	100.0	100.0

(1) Per cent detail may not add to 100 because of rounding.

(2) R. = Graduate student enrolment/total enrolment.

A study by the National Science Board, to which we have referred above, following a methodology developed by Cartter (1) sought to establish correlations between the quality of doctoral institutions and aspects of their graduate programmes. The N.S.B. study uses seven quality classes, dividing institutions between them by combining peer group judgments of the quality of the individual departments within each institution. Whilst this definition of quality is open to objection, the characteristics of graduate education correlating with high quality, in this sense, are of interest. We list a few such correlations below:

- the magnitude of an institution's doctoral programme - though not of its master's programme - is proportional to its quality;
- the magnitude of Federal research funding is correlated with institutional quality;
- quality is correlated with the ratio of the number of Ph.D.'s awarded to the total graduate student enrolment;
- a high graduate student/faculty ratio - though a low undergraduate student/faculty ratio - is associated with high quality.

Having outlined briefly the factors which serve to specify the fundamental diversity of American higher education, it is now possible to utilise some global indicators. The simplification inherent in any macro-description of postgraduate education should, however, be all too apparent.

TABLE IV
RATIO OF POSTGRADUATE TO TOTAL ENROLMENT

%									
<u>1900</u>	<u>1910</u>	<u>1920</u>	<u>1930</u>	<u>1940</u>	<u>1950</u>	<u>1955</u>	<u>1960</u>	<u>1962</u>	<u>1964</u>
2.5	2.6	2.6	4.3	7.1	11.0	9.0	9.9	10.0	10.4

(d) Transitions

In countries with a more centralised system of finance and control of higher education than obtains in the United States the transition ratio is a valuable input to the policy-making process. Although in American terms it seems of less interest than indicators such as total graduate enrolments or Ph.D. production, it is useful for international comparisons (2).

Inevitably, subject of study is not the only predeterminant of advanced study: institution of undergraduate study also seems to exercise a significant effect. Thus Berelson (*loc. cit.*, p. 131) writes: "The median undergraduate college sends 10 to 15 per cent of its graduates on to graduate school in the arts and sciences, but the range is

(1) Allan M. Cartter: An Assessment of Quality in Graduate Education (American Council on Education, 1966).

(2) And in a "post-industrial society" in which higher education is all but universal, it may attain the social significance now possessed by the measure of transitions between secondary and tertiary education.

TABLE V
TRANSITION TO FULL-TIME GRADUATE STUDY 1951 AND 1958

Year of Graduation	Male and Female Students					
	Percentage Going on to Full-time Study: Enrolling in Graduate School Following Term					
	All Fields		Natural Sciences		Social Sciences	
	Men	Women	Men	Women	Men	Women
1951	16	8	36	17	23	12
1958	17.6	5.4	34.0	10.6	26.1	10.1

from less than 5 per cent to well over 40 per cent". Thus, the N.S.B. Report on Graduate Education found that those who first graduate from the large rich institutions are more likely eventually to receive doctorates than are those coming from smaller graduate institutions. Not only do more Ph.D.'s come initially from undergraduate schools in the large research-oriented institutions, but proportionately more do (1). Over a wider perspective (i.e. looking also at undergraduate schools of non-graduate institutions), the same picture holds, although some liberal arts colleges provide notable exceptions (2). Berelson (p. 143) concludes that the decision to go on to doctorate work is "less the result of a decision and much more the result of drift". Presumably to those from the large institutions postgraduate study is a more "visible" alternative. [The situation is rather different for those proceeding to professional schools.]

Is there any evidence that many students who would like to go on to academic postgraduate work are unable to gain admittance? Berelson, writing about the late 1950s, concluded that: "everybody who wants to get into graduate school does get in" (p. 144). There is, then, a true social-demand determined situation. But a second prerequisite is financial support, and its availability is considered in section II.

II. SOURCES OF FINANCIAL SUPPORT

American graduate students are commonly supported in one of five ways:

- graduate fellowship
- graduate traineeship
- graduate teaching assistantship
- graduate research assistantship
- private sources

The first four mechanisms of finance may employ institutional funds (or state or local funds which in the case of public universities and colleges are not distinguishable), Federal funds, or foundation/industrial funds. As a result of the post-war explosion of Federal funding of research in the natural sciences, Federal funds for fellowships,

(1) N.S.B. Report, pp. 69-73.

(2) On this see R. Knapp and J. Greenbaum: The Younger American Scholar: Their Collegiate Origins (Chicago, 1953).

assistantships, etc., have expanded rapidly. Students in the natural sciences have had to rely less on their own funds than once they did, and many are now supported - at least in their second and subsequent years of graduate study - from funds deriving from one of the great Federal agencies concerned with basic research (N.S.F., P.H.S./N.T.H., N.A.S.A., etc.) or with graduate education (principally the N.D.E.A.). In the years following on World War II the Veterans Administration (V.A.) permitted many ex-members of the armed forces to continue their interrupted studies and in the 1950's it was a major source of student support. Before we elaborate on the modes of finance listed above, it is useful to sum up statistically the changes that have taken place as a result of growing Government interest in the natural sciences. This is possible as a result of an N.A.S.-N.R.C. study in which questionnaires were sent to samples of all recipients of the Ph.D. from 1935 to 1960 (at five-year intervals): over 14,000 doctorate holders in all. Respondents were asked to indicate the percentages of their funds which had derived from each of a variety of sources. We have combined some of these data and simplified the results, for a variety of fields, in order to show the changing role of Federal finance.

In Table VI the increasing levels of "other Federal" aid in physical and bio-sciences should be noted, as should the differences in recourse to private funds (e.g. loans, family, own earnings) between students of the natural sciences, the social sciences and the humanities. [The situation in the 1960s and the prospects for the early 1970s are dealt with below.]

In the following part of the report the types of support open to postgraduate students will be described. Fellowships and traineeships are similar in that both enable the recipients to spend virtually all their time on studies leading to their degrees. The difference between the two varies from institution to institution, but here they will be distinguished on the basis of the N.S.F.'s usage (which is similar to that of the N.I.H.).

"Fellowships are awarded - in national competition - on the basis of merit and ability; the Foundation makes these awards directly to individual applicants. Traineeships are awarded locally by institutions receiving N.S.F. grants for supporting graduate training programs." (1)

The traineeship programme of N.S.F. was introduced in 1964, and institutions with at least one doctoral programme in any science field may apply for these traineeship grants. In other words, such awards are made to the stronger institutions which have facilities for expansion of graduate enrolment. [There are currently 216 universities supported in this way by N.S.F.] The N.S.F.'s fellowship programme was inaugurated in 1951, almost immediately after the Foundation's establishment; this is for the support of the most able individuals, irrespective of their institution of proposed study. The assistantship requires some services from the student in return for his stipend, but the exact nature of this varies. When holding a research assistantship - often financed from a Federal research grant to his supervisor - the student may frequently use some of the work required of him towards his dissertation. The teaching assistantship clearly keeps him from his research for some of the time, but it may be considered a useful contribution to his training as a future university teacher. It is often stated that many colleges and universities would be unable to offer the amount of instruction that they do without such assistance from postgraduate students (2).

(1) N.S.F. Report for 1969, p. 70.

(2) A study by Orlans (The Effects of Federal Programs on Higher Education, Chapter 4) indicates that Federal provision of duty-free fellowships, by removing the need to teach from the best students, has reduced the quality of undergraduate instruction.

TABLE VI
CHANGING FEDERAL FINANCE OF DOCTORAL STUDY
1935-1960 FOR SELECTED AREAS

Area of Study	Year of Graduation	Source - % of Funds			
		V.A.	Other Federal	University and Other Fellowship	Private
Biosciences	1935	0.5	0.7	57.1	41.7
	1940	0.0	1.5	56.1	42.4
	1945	0.9	2.2	55.5	41.4
	1950	25.6	6.2	38.9	29.3
	1955	11.1	10.6	31.4	36.9
	1960	7.5	16.2	43.3	33.0
Physical sciences	1935	0.0	0.3	49.4	50.3
	1940	0.1	0.5	55.3	44.1
	1945	0.3	5.1	64.4	30.2
	1950	22.1	8.1	36.8	33.0
	1955	10.6	16.4	38.8	34.2
	1960	7.4	16.2	46.0	30.4
Social sciences	1935	0.0	0.1	34.4	65.5
	1940	0.2	0.3	38.9	60.6
	1945	1.0	1.0	42.4	55.6
	1950	27.7	0.8	26.1	45.4
	1955	20.2	2.4	29.2	48.2
	1960	12.0	1.7	36.8	49.5
Arts, Humanities	1935	0.0	0.0	32.8	67.2
	1940	0.2	1.8	32.3	65.7
	1945	0.7	0.0	34.4	64.9
	1950	21.7	0.0	22.6	55.7
	1955	18.9	1.5	28.8	50.8
	1960	10.4	3.1	31.2	55.3

It has already been indicated that various Federal agencies, as well as other sources, are involved in the provision of the necessary funds. Furthermore, funds from different sources are typically used to provide different types of support, depending upon the objectives of the source agency or institution. For example, the bulk of students supported from university funds are paid as teaching assistants, with smaller numbers of fellows and research assistants. Federal agencies support very few students as teaching assistants; their support is principally of research assistants, under research grants, and fellow/trainees. The proportions in which support is divided between these two types will depend upon the extent of the educational component of their total mission.

In this, Federal agencies clearly differ greatly: whilst N.S.F. and N.I.H., with a high degree of concern for advanced education, have typically had strong fellowship/traineeship programmes, other agencies (e.g. A.E.C., D.O.D.) have not (1).

The overall levels of student support from public funds, and the distribution of types of support, vary considerably between areas of study and types of institution, and between types of department. Because surveys of support rarely take the same population in terms of institutions or departments covered, they are generally of limited comparability owing to the dependence of the parameters of interest on institutional type.

Table VII shows the growth in Federal support of postgraduate (predoctoral) students by means of fellowships and traineeships, and the post-1968 decline.

TABLE VII
FEDERALLY SUPPORTED PREDOCTORAL FELLOWS AND TRAINEES
(ALL FIELDS)

<u>Fiscal Year</u>	<u>No. of Students</u>
1960	9,395
1961	13,716
1962	15,974
1963	19,037
1964	24,413
1965	31,185
1966	45,265
1967	56,945
1968	57,586
1969	48,986
1970	41,000*
1971	36,000*

* Contribution from National Institutes of Health estimated for these two years.

Research assistantships have been relatively uncommon outside the natural sciences, engineering and psychology, whereas teaching assistantships have been found to be in proportion to the need for service teaching at the undergraduate level. So far as source is concerned, the Federal government has been a major source of funds in just those fields where considerable numbers of students were supported as research assistants. Data referring to 1969 are presented in Table VIII, but these relate only to natural, applied and social sciences. Furthermore, they were collected only from doctorate-awarding departments. In Table VIII the distribution of support for each area of study is shown. Fellowships and traineeships together are, curiously enough, least common in physical and mathematical sciences, but this may be a consequence of the large numbers supported as teaching assistants and (in physical sciences, although not

(1) All this is open to re-assessment in the light of the Mansfield amendment, which is likely to reduce the weight given to basic scientific and educational criteria in supporting university science by mission-orientated agencies.

TABLE VIII

DISTRIBUTION OF TYPES OF SUPPORT BY AREA FOR
FULL-TIME POSTGRADUATE STUDENTS IN Ph.D.-AWARDING DEPARTMENTS (1)

(1969)

Area of Science	Total		Fellowships and Traineeships		Research Assistantships		Teaching Assistantships		Other Types of Support	
	No.	%	No.	%	No.	%	No.	%	No.	%
Engineering	30,820	21.8	8,072	26.2	9,048	29.4	4,213	13.7	9,487	30.8
Physical sciences	30,175	21.4	7,096	23.5	9,404	31.2	10,072	33.4	3,603	11.9
Mathematical sciences	11,727	8.3	2,794	23.8	1,154	9.8	4,798	40.9	2,981	25.4
Life sciences	27,588	19.5	9,692	35.1	6,399	23.2	6,088	22.1	5,409	19.6
Psychology	11,918	8.4	4,738	39.8	1,693	14.2	2,260	19.0	3,227	27.1
Social sciences	28,971	20.5	9,342	32.2	2,773	9.6	5,560	19.2	11,296	39.0
TOTAL	141,199	100.0	41,734	29.6	30,471	21.6	32,991	23.4	36,003	25.5

(1) In the following tables percentages are of all students in each area of study. In Table IX, United States students and foreign students are given as a percentage of independent totals. Support of American students from foreign sources is negligible.

mathematics) as research assistants. The category "other" is said to be principally, although not entirely, equivalent to support from private sources. To the extent that this is so, social scientists are least well provided for. Research funds, permitting the employment of doctoral candidates as research assistants, are less common in mathematics and social sciences.

Table IX shows the distribution of sources of support for the same areas of study, giving United States and foreign students separately.

Table IX shows that the major source of funds for United States students is the Federal Government, although this is much less significant for social scientists, the university/State Government, except in engineering which has, presumably, little need of teaching assistants, and private sources, including loans. The last is particularly common for social scientists. Foreign students do even better from institutional/State funds (presumably they are more inclined to accept teaching fellowships) much less well from Federal funds, and rely to some extent on foreign sources of finance, especially in engineering and social sciences.

We have indicated already that there is some correlation between source and type of finance. This is made explicit by Table X.

Table X also gives some indication of the dependence of graduate study on funds provided by the more important Federal agencies (D.O.D. is included in "other"). The extent of these dependences will be important when current policy in certain agencies is examined (see below).

There is little doubt that institutional factors affect the types of funds available to postgraduate students. Table VIII, covering only the strongest doctorate-awarding departments in the relevant 219 institutions, shows that in the physical sciences only 12 per cent of students had no stipend, whereas a survey of (1) all institutions awarding master's or doctor's degrees (i.e. including some less strong colleges) found that over 40 per cent had none in 1954. Not all of the difference between the two percentages is accounted for by the passage of time. The selective location of Federal funds in the stronger institutions means that finance is available in such institutions - and indeed in certain departments within these institutions - which is not available outside them. This is particularly true of Federal research funds, although it is also true of the N.S.F. traineeship scheme funds, for example. A number of authors have drawn attention to the concentration of Federal R & D funds in relatively few institutions. Thus Orlans (1962, p. 141) states that in 1958 the leading six institutions received 28 per cent of Federal R & D funds, the leading 20 received 54 per cent, the leading 36, 73 per cent. Subsequent expansion of the N.S.F., which has adopted a policy of upgrading second rank universities and colleges, has probably had some diffusional effect by now; but clearly the 400-500 institutions awarding graduate science degrees do not have equal access to Federal research funds. Even within the elite group of 200 or so universities and colleges awarding science doctorates, pronounced differences have been shown to exist between departments awarding the doctorate and those awarding only the M.Sc. Students in the latter are far less likely to obtain a graduate fellowship or a research assistantship. This is brought out by Table XI, which compares the two types of department within this top 200.

(1) Graduate Student Enrollment and Support (N.S.F. 57-17, 1957).

TABLE IX

DISTRIBUTION OF SOURCES OF SUPPORT BY AREA FOR THE UNITED STATES,
AND FOREIGN FULL-TIME POSTGRADUATES IN Ph.D.-AWARDING DEPARTMENTS

(1966)

Area of Study	U.S. Government		Institution or State Government		Industry		Foundations		Other		Loans		Foreign
	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	U.S.	Foreign	Foreign
Life/Medical sciences	44.6	29.6	35.8	33.8	1.5	2.7	1.5	7.5	0.7	0.2	15.8	9.6	16.6
Psychology	42.2	15.9	32.4	51.0	0.6	0.3	1.5	3.4	1.9	2.8	21.4	14.7	11.9
Engineering	47.3	21.5	25.9	36.0	9.5	4.1	2.0	2.2	0.4	0.3	14.8	8.0	27.9
Mathematics	32.1	14.2	45.1	57.6	1.2	0.6	1.1	1.9	0.6	1.0	19.9	12.7	12.0
Physical sciences	48.4	32.7	39.0	44.9	2.6	2.2	1.8	3.0	0.4	0.1	7.7	5.7	11.4
Social sciences	24.6	8.4	35.0	36.9	0.7	0.6	4.5	10.6	1.0	0.7	34.1	15.9	26.9
ALL	40.9	22.1	35.0	39.6	3.1	2.5	2.2	4.7	0.7	0.4	18.0	9.7	21.0

TABLE X
FULL-TIME GRADUATE STUDENTS IN DOCTORATE DEPARTMENTS,
BY SOURCE AND TYPE OF SUPPORT, 1969

Source of Support	Total	Fellow- ships and Trainee- ships	Research Assistant- ships	Teaching Assistant- ships	Other Types of Support
Total	141,199	41,734	30,471	32,991	36,003
All U.S. sources, total	138,954	40,465	30,414	32,991	35,084
U.S. Government	51,620	28,707	19,646	327	2,940
Atomic Energy Commission	2,940	500	2,395		45
Department of Agriculture	1,091	56	949		86
Department of Defense	4,963	370	3,525		1,068
Department of Health, Education, and Welfare, total	20,611	16,895	3,492	64	160
National Defense Education Act	6,858	6,753	94		11
National Institutes of Health	12,189	9,086	2,965	29	109
Other H.E.W.	1,564	1,056	433	35	40
National Aeronautics and Space Administration	2,683	1,353	1,242		88
National Science Foundation	12,981	7,255	5,225	122	379
All other U.S. Government agencies	6,351	2,278	2,818	141	1,114
Other U.S. sources	87,334	11,758	10,768	32,664	32,144
Institutions and State and local governments	50,471	7,191	8,451	32,524	2,305
Private foundations	3,836	2,515	872	78	371
Industry	4,568	1,663	1,142	9	1,754
Self-support	26,307				26,307
All other U.S. sources	2,152	389	303	53	1,407
Foreign sources, total	2,245	1,269	57		919

TABLE XI
TYPE OF SUPPORT OF GRADUATE STUDENTS: COMPARISON OF
DISTRIBUTION IN Ph.D.-AWARDING AND M.Sc.-AWARDING DEPARTMENTS

(1966)

	Physical Sciences		Social Sciences		All Sciences	
	Ph.D.	M.Sc.	Ph.D.	M.Sc.	Ph.D.	M.Sc.
Fellowship	17.3	7.8	28.3	7.1	19.6	6.5
Traineeship	9.0	6.9	4.7	4.9	11.5	5.4
Teaching assistantship	31.3	48.5	17.2	28.2	22.4	31.3
Research "	30.9	12.1	11.0	14.0	22.3	16.1
Other (private)	11.5	24.7	38.8	45.8	24.2	40.7
ALL	100	100	100	100	100	100

In all cases, teaching assistantships are a very much more common means of student support in M.Sc.-granting departments, but where these are available in only limited numbers (e.g. social science) students are thrown back on their own resources far more than perhaps they would be in higher-level departments. Although we have not produced any evidence in support, it is possible that a precisely similar comparison may be made between Ph.D.-awarding and master's-awarding institutions.

Current Developments in Federal Support

We have shown that Federal support of postgraduate students is particularly common in some areas of study (e.g. the physical sciences) and is correlated with departmental strength. Thus, a relatively small percentage of university departments are likely to be highly dependent upon Federal sources for the continuation of their research and postgraduate programmes, with a fading penumbra of dependence around this core. This is the background against which the continuing (1) debate on science policy in the United States must be viewed. In the Figure below we have made an attempt to summarise scheduled, or anticipated, developments in Federal support of postgraduate study on the part of four major agencies. The overall picture is one of continuing reduction in Federal support - a reduction of 6,000-7,000 fellowships between 1970 and 1971 seems a reasonable interpretation of the figures. One consequence derives from the fact that the N.S.F. is expanding its fellowship programme at the expense of its traineeship programme. Fellowships are awarded to individuals who may take them where they will: they take them to the strongest, most prestigious institutions. Traineeships are awarded to institutions for allocation by them, and they are spread more widely over 200+ institutions. It is therefore the 150 or so second rank institutions whose postgraduate work and research will suffer most particularly. There is also a debate about the possible effects of a Federal switch to principally loan-finance. This is discussed in section VII.

(1) In the summer of 1970, debate over the appropriations bills (i.e. the science budgets of relevant agencies) for fiscal year 1971 (i.e. July 1971-July 1972) was still continuing in Congress.

FIGURE I

AGENCY	DEVELOPMENTS (1)			
N.S.F.	Reduction in total number of traineeships owing to no new awards being made in f. y. 1971. Slight compensatory increase in number of fellowships.			
		1969	1970	1971
	fellowships	2,500	2,200	2,530
	traineeships	5,238	5,123	3,000
N.I.H.	Phasing out of predoctoral fellowship programme, with greater emphasis on training grants. Overall net reduction seems likely in view of current trends.			
	1968: about 10,000 fellowships/traineeships at predoctoral level			
	1969: about 5,000 fellowships/traineeships at predoctoral level			
	e.g. N.I.M.H. cutting predoctoral fellowship programme from 750 to 491 (1970-1971).			
N.D.E.A.	Continued drastic reductions in the number of fellowships (in all fields)			
	f.y.	1968	1970	1971
	No. new fellowships	6,000	2,370	2,200
	Total no. current	15,000		7,500
N.A.S.A.	Continued run-down of predoctoral fellowships and of total R & D obligations at universities from which research assistants are funded. In 1968 N.A.S.A. supported 1,300 students, of whom the last few will finish in 1971.			
	Total obligations to universities			
	1969:	\$130 M		
	1970 (est.):	\$111 M		
	1971 (est.):	\$ 90 M		

(1) Source: Science.

III. BALANCE BETWEEN RESEARCH AND COURSE-WORK, BY FIELD

Whilst graduate students in some areas tend to be working for their doctorate, in other areas it is very uncommon to proceed past the master's. To what extent are different fields of graduate study orientated in one or other directions? This is the question to be discussed in this section.

Unfortunately, there are no enrolment data separating the two classes of student and it is necessary to seek other indices. One such index is the ratio of doctorates to master's degrees awarded in different fields. In Table XII such ratios are presented at three points in time, for major areas of study.

TABLE XII
RATIO OF MASTER'S TO DOCTOR'S DEGREES
BY AREA OF STUDY

	1954-55	1959-60	1964-65
Pure science	1.7	2.4	2.3
Social science	7.5	8.6	9.0
Humanities	3.7	4.5	5.4
Fine arts	11.8	9.9	9.9
Technology	7.8	9.3	5.8
Agriculture	2.7	2.9	2.6
Medical science	9.2	17.4	14.6
Education	18.8	21.0	16.2
Law	17.0	21.7	23.0
Other	10.9	15.8	15.8
ALL	6.6	7.6	6.8

This is, however, an index of slight value since the master's degree has a dual status: it serves both as terminal degree and as intermediate degree for those going on to take doctorates. [The status of the master's degree is discussed in section V.7] If, as in some fields (see section IV(c), Table XVI) the majority of doctoral students take the master's degree en route, a rapid rise in doctoral students will grossly inflate the index expressed by the above table. Another index which is available (ratio of first year/later year students) is also subject to the same confusion: it may be high either as a consequence of a large proportion of master's students (who may be taking one year courses) or of rapid doctoral-level expansion. A third potential measure is the subsequent employment of master's degree graduates; but it is a measure of the devaluation of this degree that such information does not appear to be collected (in contrast to the sophisticated Doctorate Record File kept by the N.R.C.). Therefore, one can conclude tentatively, from Table XII, that the master's degree is regarded as a terminal degree principally in the professional fields, and rather less so in the arts and sciences.

IV. THE NATURE OF THE Ph.D.

(a) The Growth of Doctoral Education

Doctoral education has, since World War II, been the fastest growing segment of American higher education. This is shown by Figure II, and also by the figures below:

1964-65 output on the basis of 1950-61 output = 100

First degree level	168
Master's level	196
Doctorate level	259

Within this overall growth, certain fields have expanded faster than others: the natural sciences have had the largest share, among areas of study, over a very long period. They have not expanded their share of the total output, however, as might have been anticipated. Fields which have most notably expanded their share of the total output are education and engineering, principally at the expense of the humanities. This is shown by the following table.

TABLE XIII

PERCENTAGES OF DOCTORATES IN SELECTED AREAS OF STUDY
AT DIFFERENT PERIODS

	1911-15	1921-25	1931-35	1941-45	1951	1961	1964
Natural science	44.2	44.1	45.4	47.9	39.8	32.9	32.6
Social science	10.6	11.0	9.5	9.8	3.1	11.5	11.2
Humanities/Arts	37.9	30.6	26.7	25.8	24.5	23.1	21.0
Engineering	0.4	1.3	2.5	1.6	8.2	8.9	12.9
Education	4.9	10.9	12.4	11.3	14.8	16.5	16.5

We have already made reference to the particular significance for this growth of the massive injections of Federal funds for academic science which began towards the end of World War II.

(b) Transition Ratios by Field

Estimates of the percentages of graduates who go on to further academic study in various fields are available from a study carried out for the National Science Foundation by the Bureau of Social Science Research (1). Data quoted below are taken from this survey and relate to individuals graduating at the first degree level in June 1958. This study determined which of this cohort of graduates enrolled in graduate school at any time between graduation and the beginning of the 1960-61 academic year. In fact, about 44 per cent of all graduates did register (47 per cent of men and 38 per cent of women); the majority of men registered at the beginning of the academic year, immediately following their graduation. Sixty per cent of the women who enrolled did so after some

(1) N.S.F. Two Years After the College Degree (N.S.F. 63-26).

delay. The broad outline of this transition has been given in section I; here more detailed information is given for selected fields. Table XIV shows, for selected fields, the percentage of graduating students who went on to some further study in the two years following their graduation and the percentage of these who enrolled (full-time or part-time) in the subsequent term (Fall 1958). This table shows that most academic science and social science fields send about 55 per cent of their graduates on for further study: physics is rather high and premedical education (inevitably) very high. Rather smaller percentages stay on of those in the more professional fields (engineering, agriculture). Of this 55 per cent, only about 40 per cent (i.e. 22 per cent of the total) actually go straight on to full-time graduate study (a very much smaller percentage in mathematics). Considerable numbers either register on a part-time basis or delay before registering. [These factors help to explain the enormous stretch out of American doctoral study discussed in section IV(c).]

Table XV gives some idea of what those of the 1958 graduates (in the selected fields) who were candidates for advanced degrees in summer 1960 were actually doing. Of the 13,914 graduates in June 1958 (14,313 minus pre-medical graduates), 16 per cent were candidates for advanced degrees and 8 per cent had received their master's; 45 per cent of those who were working for their master's degrees were doing so in their major field of undergraduate study and the same was true for 69.5 per cent of those studying for the doctorate; 23 per cent of the master's candidates were studying education.

(c) Content, Duration, and Success or Failure

Content

Clearly one cannot survey the intellectual content of Ph.D. programmes in all disciplines in a paper of this kind; we are more concerned here with the kinds of relevant things that doctoral students do, ought to do, and ought not to do. Traditionally, the doctoral programme in America is made up as follows:

- | | |
|------------------------|--|
| 1st year: | advanced study; |
| 2nd year: | ditto; but the student searches for a dissertation topic and may start work on it; |
| 3rd year
(et. seq.) | research, with probably only very little formal instruction. |

In some disciplines the programme of advanced study may be terminated formally by an examination leading to the master's degree. The percentages of doctorate recipients who also have a master's varies greatly from field to field, as shown for a few fields in Table XVI.

TABLE XIV

GRADUATES, BY FIELD, ENROLLED IN GRADUATE OR PROFESSIONAL SCHOOL
FOR AT LEAST ONE TERM IN THE TWO YEARS FOLLOWING
THEIR GRADUATION (IN JUNE 1958)

Undergraduate Field	No. Graduating (June 1958)	Percentage Enrolled for at Least One Term	Percentage of these Enrolling in Fall 1958			Not Enrolling in Fall 1958
			Full-time	Part-time	Courses only	
Mathematics	857	54	22.4	13.7	17.4	46.5
Biological sciences	1,282	65	50.4	7.1	17.4	25.1
Pre-medical subjects	399	91	78.3	2.1	12.0	7.6
Chemistry	891	59	50.1	13.8	19.0	17.1
Earth sciences	332	43	43.0	8.3	17.4	31.3
Physics	353	72	40.4	15.7	23.5	20.4
Other physical sciences	135	58	33.3	17.9	12.8	35.9
Engineering	3,872	36	22.7	20.2	21.8	35.3
Agriculture	564	33	29.9	19.0	14.1	37.0
Psychology	817	55	44.9	9.7	13.9	31.5
Other social sciences	4,811	53	39.9	7.8	15.3	37.0
All selected fields	14,313	51	39.3	11.4	17.2	32.0
All fields	31,999	44	30.2	10.7	16.5	42.6

TABLE XV

JUNE 1958 BACHELOR'S DEGREE RECIPIENTS
WHO WERE CANDIDATES FOR ADVANCED DEGREES IN SUMMER 1960,
BY SELECTED FIELD OF UNDERGRADUATE MAJOR AND BROAD FIELD OF GRADUATE SPECIALISATION

Undergraduate Major	Number of 1958 Bachelor's Degrees	Master's Degree Candidates (1)					Doctor's Degree Candidate (2)						
		Total Number	Per cent Distribution				Total Number	Total	Per cent Distribution				
			Total	Same Field	Educa- tion	Natural Sciences and Engineer- ing			All Other (3)	Same Field	Natural Sciences and Engineer- ing	Social Sciences	All Other (3)
Total, selected fields	13,914 (4)	1,811	100.0	45.4	22.9	9.3	22.4	379	100.0	69.5	10.5	2.1	17.9
Mathematics	857	156	100.0	46.2	32.0	10.3	11.5	28	100.0	78.6	3.6		17.8
Biology and other biological fields	1,282	160	100.0	33.1	21.9	17.5	17.5	43	100.0	53.5	32.6		13.9
Engineering	3,872	412	100.0	71.8	3.2	7.3	17.7	78	100.0	71.8	11.5		16.7
Chemistry	891	106	100.0	53.8	12.3	17.9	16.0	40	100.0	70.0	10.0		20.0
Earth sciences	332	46	100.0	58.7	23.9	2.2	15.2	9	100.0	(5)			(5)
Physics	353	80	100.0	57.5	10.0	20.0	12.5	37	100.0	67.6	13.5		18.9
Other physical sciences	135	27	100.0	11.1	22.2	55.6	11.1	2	100.0		(5)	(5)	
Agriculture	564	51	100.0	39.3	29.4	17.6	13.7	20	100.0	70.0	10.0	10.0	10.0
Psychology	817	117	100.0	44.4	31.6	2.6	21.4	32	100.0	84.4	6.3	3.1	6.2
Social sciences	4,811	656	100.0	29.9	34.5	2.3	33.3	90	100.0	33.3	2.2	4.4	26.7

(1) Limited to candidates for 1st advanced degree.

(2) Limited to candidates for 2nd advanced degree.

(3) Includes those who indicated candidacy for the degree but did not report the field of study.

(4) "Total, selected fields" does not agree with that shown in Table V due to exclusion of pre-medical fields in this table.

(5) Percentages not computed in cases where the total is less than 15.

Source: National Science Foundation, Two Years After the College Degree, N.S.F. 63-26.

TABLE XVI
PERCENTAGE OF DOCTORATE RECIPIENTS (1968)
ALSO HOLDING A MASTER'S DEGREE - SELECTED FIELDS

Chemistry	39.6
Basic bio-Science	56.6
Physics	64.2
Economics	76.5
Sociology, History	87
Engineering	88.6
Business administration	93.3
Education	97.0
(All	79.2)

In other words, about half the students in basic sciences take the master's, over three-quarters in social sciences and the humanities, and virtually all in the professional fields.

There is probably more emphasis on course-work than is the case at this level in the majority of countries. In principal, at the graduate level course-work can be used in either of two ways: to introduce an element of specialisation, or to introduce an element of breadth when the student is working on a narrow topic of research. Berelson discusses this possible dichotomy - depth versus breadth - in some detail (1). He concludes that a combination of the two is impossible, and that specialisation at the doctoral level is inevitable: "for the purposes of scholarship, there is no substitute for the discipline of a discipline". A second issue in American graduate education derives from the fact that it used to be thought of as the preparation for college teaching. But the American academic system exerts no pressure to engage in research upon the majority of its members. In other words, faculty are being trained in research in order to teach. Ought there to be a pedagogic component in their education? In fact, this argument (rejected by Berelson in 1959) is an anachronism. Doctoral education in arts and science is decreasingly a professional preparation for college teaching; if once it appropriately had a pedagogic component, that time has passed. It could also be argued that doctoral education in science is now a professional training of a different kind, for there now exists a professional scientist role. It is here that another and a very real dichotomy in doctoral education is thrown into sharpest relief. If it is particularly an American problem now, this is only because of American scientific leadership; it is a problem which accompanies scientific success.⁷ The problem derives from the educational versus professional conception of doctoral education. In some branches of science, students are trained in the ways of working of the discipline, but in a way that can be said to encroach upon the traditional meaning of the Ph.D. Teamwork is a way of working which is inevitable in some branches of science (e.g. high energy physics, radio-astronomy and perhaps increasingly in large-scale social research) and students must pursue their graduate research in this way. A student participating as one of a team in a large-scale piece of sponsored research is in no way responsible for his own piece of research. Students are largely denied the privilege of learning from their own mistakes. Because of

(1) Berelson (op. cit.), pp. 59-64.

the division of labour, a doctoral thesis can never stand on its own as an "independent contribution to the body of knowledge" (1). One of America's most famous high energy physicists has attempted to answer this criticism by arguing that although fields like his own do deprive the student of some autonomy, of some responsibility, they do enable him to participate in what is really a most exciting, difficult, and intellectually stimulating branch of science (2). Although high energy physics may indeed have this particular stimulation to offer, it could be that the disadvantages for the graduate student of team research are even now spreading into far more mundane fields.

Duration of Doctoral Study

Berelson (loc. cit., p. 157) points out that there are three possible measures of the duration of doctoral study, each "a reasonable and useful measure, depending on the question for which it is the answer". One may measure:

- (i) the time elapsing between receipt of the bachelor's and receipt of the doctor's degree;
- (ii) actual time between the two degrees during which the candidate was registered for the degree;
- (iii) actual time spent doing relevant work for the degree itself.

There is no doubt that these measures differ very considerably, the first being very much the greatest. The first two are given, for broad subject groups, in Table XVII below.

TABLE XVII

TWO MEASURES OF MEDIAN TIME BETWEEN BACCALAUREATE AND DOCTORATE,
AT THREE POINTS IN TIME (YEARS)

	1958-60		1961-63		1964-66	
	(1)	(2)	(1)	(2)	(1)	(2)
Physical sciences/Engineering	6.6	4.9	6.6	5.0	6.3	5.1
Biological/Health/Agricultural sciences	7.7	5.1	7.8	5.2	7.3	5.3
Social sciences	8.7	5.2	8.9	5.3	8.0	5.3
Arts and Humanities	9.9	5.7	10.1	5.7	9.5	5.7
Professional fields	11.3	6.1	10.8	5.9	10.8	6.0
Education	14.0	6.6	13.0	6.6	13.8	6.8
ALL	8.6	5.2	8.8	5.3	8.2	5.4

(1) Time elapsed

(2) Time registered

(1) For a wide-ranging critique along these lines see O. Carmichael: Graduate Education.

(2) W. Panofsky: "Big Science and Graduate Education" in Science Policy and the University.

In arts and sciences, therefore, total time elapsing is some 1½ to 3 years greater than time spent registered for the doctoral degree. In professional subjects and education the difference is much greater: 5 to 7 years. These differences reflect the time which many students have spent in employment between first graduating and eventually entering graduate school (1). Duration in its largest sense clearly differs considerably between fields: graduates in education spend substantially more time in employment (or, substantially more graduates spend some time in employment) than do graduates in physical sciences (2). Duration in the sense of time spent registered for the degree differs very much less, and between arts and science subjects by only 0.6 years (1964-66). There seems to be some slight increase in median registered time between 1958-60 and 1964-66. The third measure - time spent doing work directly relevant to the degree itself (or time taken in "full-time equivalent" years) - is given in Table XVIII.

TABLE XVIII

MEDIAN TIME BETWEEN BACCALAUREATE AND DOCTORATE
FULL-TIME EQUIVALENT YEARS (1957 RECIPIENTS)

Physical sciences (excluding engineering)	3.5
Biological sciences	3.3
Social sciences	3.7
Humanities	3.3
Education	2.8
Engineering	3.1
ALL	3.2

In arts and sciences these figures are some 1½ to 2 years less than the time spent registered for the degree. They reflect the considerable proportion of their graduate education time many students spend doing other things. In other words, the high percentage of part-time students in some fields (this percentage varies between about 32 per cent in pure sciences, through 40-50 per cent in arts and social sciences, to over 80 per cent part-time students in education) results in much of the time registered being spent on other things. It is not surprising that there is a correlation between the percentage of students in a field who pursue their graduate study on a full-time basis and the amount of finance available in a field. Because substantial numbers of fellowships, etc., are available to physical science students, few of these need to support themselves by part-time work. The very opposite is true of education, for example.

There is little doubt that the stretch out of doctoral education is an issue of some importance in the United States, and it is usually the most pessimistic measure of duration (overall elapsed time) which is quoted. It is very important to point out that this is grossly inflated by, on the one hand, the pregraduate study activities of students (teaching, military service, Peace Corps, or other employment), and, on the other hand, the part-time employment of many students to support themselves during study. [It is of course true that for many students this part-time employment is teaching. Though perhaps

(1) See section IV(b), Table XIV, for percentages not enrolling immediately.

(2) Berelson (p. 159) points out that about half the students in his (1957) sample in arts and sciences had gone straight on to graduate study, and about 35 per cent into professional fields.

not relevant to their degrees, teaching practice could be of value in subsequent employment.⁷ The main argument against this stretch out is that students become available for employment at a rather advanced age. Thus, the age by which 50 per cent of doctoral candidates have received their degree is 31.6 years. But by the time 75 per cent have graduated, the age is 37.0 years, including variations from 31.3 in mathematics and physics, 30.7 in chemistry, 33.4 in engineering, to 35.7 in economics, 39.4 in sociology, and 43.4 in education.

However, the fallacy in the "postponement of employment" argument is that the cause of the prolongation of study is that students are employed - usually teaching. However, Berelson, who draws attention to this fallacy, does accept that graduate study subjects students to an over-long period of nervous strain, anxiety and pressure. There may be personal and individual, rather than social, arguments against this prolongation. In summary, therefore, it is generally agreed that the average duration of study at the graduate level in a field is highly dependent upon the amount of fellowship-type support available in the field (this conclusion is borne out by the data). Large fellowship and traineeship programmes can reduce the average time taken in pursuit of the Ph.D. in a field.

Success or Failure

What percentage of doctoral candidates in American universities fail to obtain the degree? Can anything be said about the predeterminants of success or failure? It must be pointed out that "failure" requires arbitrary definition at the doctoral level: there is nothing to prevent a student remaining registered for as many years as he chooses without making a serious effort to complete his research. Taking a cut-off of seven years, Berelson (op. cit. p. 168) took an opinion poll of deans, who suggested an attrition (or failure) rate of about 40 per cent.

Wright (1), studying a sample of almost 200 graduate students in one large university, found a higher attrition over a longer period (11 years), as the following table shows.

TABLE XIX
SUCCESS AND FAILURE IN EARNING GRADUATE DEGREES
AFTER 11 YEARS (1951-1962)

(percentages)

Degree Desired in 1951	Degree Obtained by 1962			
	Ph.D.	M.A.	None	Total
M.A. only	10	50	40	100% (N = 115)
Ph.D.	33	13	54	100% (N = 61)

(1) C.R. Wright: "Success or Failure in Earning Graduate Degrees", Sociology of Education, 38 (1964), p. 73.

TABLE XX
PERCENTAGES EARNING DESIRED DEGREE, BY FIELD

	M.A.	Ph.D.
Humanities	61	30
Social science	46	32
Natural science	62	59

Thus, among doctoral candidates, over 50 per cent failed to receive any degree and nearly 70 per cent failed to receive their doctorate within 11 years. This figure is higher in arts and social sciences than in natural sciences.

The study by Wright attempted to compare successes and failures on the basis of a very large number of factors, divided into four groups:

- "endowment" - academic attainment, relevant work experience, health, financial welfare
- "motivation" - strength of motivation
- "accommodation to graduate school" - student's adjustment to the graduate-student role
- "non-academic statuses" - e.g. sex, age, nationality, marital status, socio-economic background

The majority of factors failed to divide significantly those who succeeded from those who failed. Thus, neither academic success as an undergraduate nor high motivation was correlated with success. Students who at the beginning of their studies claimed to have no financial worries were not more successful at the doctoral level - although they were at the master's level. This is in contradiction to Berelson's survey where he asked deans, faculty members and recently successful graduates what, in their views, caused attrition. Deans chose lack of financial resources as the major factor, although other faculty and recent graduates considered it much less important than lack of intellectual ability (1). It was only among the "non-academic statuses" group of factors that meaningful correlations appeared. Taking only the students who had been aiming at a doctorate, the meaningful correlations - which are not necessarily statistically significant - are listed below.

	<u>More Likely to Succeed (2)</u>	<u>More Likely to Fail</u>
Sex	Male	Female
Age	21 or younger	31 or older
Family (if married)	No children	Children
Nationality	American	Foreign
Socio-economic background	Business/White Collar	Worker

(1) Berelson (op. cit.), p. 169.

(2) i.e. pass rate higher than for the contrasting group; not necessarily higher than 50 per cent.

If this study is generally accurate, it would indicate that postponement of graduate education, by obtaining on-the-job experience, a wife, a family, and greater maturity, is not likely to be a good course of action even if motivation is thereby increased. [Of course, there may be subject differences between, for example, mathematics and sociology.]

(d) Contribution of Graduate Work to Sectoral Research Effort

In this section the contributions are estimated, in purely manpower terms, of three groups of personnel to the total research performed in the university sector. The three groups are full university faculty, temporary research staff (e.g. postdoctoral fellows), and graduate students. Estimates were made for 1961 on the basis of 10 per cent faculty time and 80 per cent research staff time being devoted to research. The student contribution was estimated not by taking a percentage of total student enrolment in requisite subjects, but by taking total number of doctorates awarded x 2. This gave a total figure roughly in accordance with an N.S.F. estimate of the number of f.t.e. research students (1). [The implied percentage of total enrolment worked out at 8 per cent of all student time.] The derived estimate of student contribution to research is given in Table XXI.

In manpower terms, therefore, students performed about one quarter of all academic research, although social science was considerably more dependent upon their efforts.

Calculation on a different basis is possible for 1966 using figures obtained as part of the OECD Statistical Survey of Resources Devoted to R & D (2). Relevant data and estimates are given in Table XXII.

TABLE XXI
F.T.E. RESEARCH EFFORT FOR 1961, BY AREA
AND STUDENT % CONTRIBUTION

	Engineering	Natural Science*	Social Science	All
Faculty	1,600	6,500	2,100	10,200
Research staff	5,100	19,300	1,000	25,400
Students	2,000	8,400	2,500	12,900
TOTAL	8,700	34,200	5,600	48,500
Student contribution %	23%	25%	45%	27%

* Includes medical and agricultural science

(1) N.S.F.: National Patterns of R & D Resources (N.S.F. 69-30), Table 2.

(2) OECD: 1967 Survey of R & D, Vol. IV (DAS/SPR/70.6). Table TH5(A) gives total manpower (including f.t.e. graduate students); Tables NT H2(A-D) give manpower excluding graduate students. Subtraction gives the number of f.t.e. students.

TABLE XXII
ANOTHER ESTIMATE OF STUDENT CONTRIBUTION
TO ACADEMIC RESEARCH, FOR 1966

	Natural Sciences	Engineering	Medical Science	Agriculture	Total
Faculty/research staff	30,291	11,315	12,167	4,813	58,586
Students	10,573	3,923	914	1,877	17,287
TOTAL	40,864	15,238	13,081	6,690	75,873
Estimated student contribution	26%	26%	7%	28%	23%

Thus, agreement is reasonably good.

(e) Unorthodox Ph.D. Schemes

If there is any orthodoxy in American higher education we have to admit our failure to locate it. To discuss the unorthodox it is necessary first to define the orthodox. In actual fact, in reporting on doctoral education in other countries this section has been used to discuss the possibilities existing for the pursuit of a doctorate outside the formal framework of the university. In many European countries where there is concern with the poor state of university-industry relations, the possibilities which exist, and the advantage which has been taken of them for doing research for a Ph.D. in industry or a government laboratory, are an important indicator of improvement. This is not a problem in America: university-government relations are so close at the research level that it is sometimes difficult to establish differences in responsibility. Whatever one may think of the ethics of the situation, there do exist a number of large government research establishments on university campuses - for example, the Federal Contract Research and Development Centers - in which students can do work towards their Ph.D.'s (1). Similarly, though regulations and experiences must inevitably differ widely from institution to institution, it is certain that in many the possibilities exist of a jointly supervised Ph.D. - part in university, part in industry. However, we are not aware of any study that has been made of this. University links with industry are neither a problem of great concern to the policy-maker nor an issue of magnitude comparable with Federal government involvement for the activist on behalf of university autonomy. Since this is not a problem of much interest on the American scene we have preferred rather to select for brief discussion one or two developments which seem to us of interest.

Particularly interesting is the "Special Projects in Graduate Education" programme of the N.S.F. (2). The N.S.F.'s Annual Report states: "The main function of this program is to promote the development and testing of innovative approaches to graduate science education". In 1969, 22 grants were made totalling \$1.1 million, or about 0.3 per cent

(1) Although probably few universities will accept "classified" or "restricted circulation" theses.

(2) National Science Foundation: Annual Report for 1969 (N.S.F. 70-1), p. 72.

of total expenditure on academic science and education. These included support for courses in esoteric areas of science (geophysical fluid dynamics, field biometeorological techniques), for planning and policy studies, and for projects related to contemporary social problems. For example, students at five universities and colleges are being trained in pest management as part of a major programme on the development of selective pest control measures. No doubt there will be additional educational spin off from the Foundation's programme of support, announced in December 1969, for "Interdisciplinary Research Relevant to Problems of our Society" (I.R.R.P.O.S.), under which some grants have now been awarded.⁷

Other reports have recommended more interdisciplinary research and graduate education programmes relevant to problems of modern society. For example, a report on "Universities and Environmental Quality" to the President's Environmental Quality Council (September 1969) surveyed research/education programmes, and considered that 12 deserved particular Federal support. This was on the grounds that they were most likely to generate new courses and curricula, and that faculty members were more involved than in other places. Socially relevant graduate education may be the most interesting development in the field.

V. OTHER GRADUATE WORK

(a) The Master's Degree

To a very large extent the American master's degree is a teaching degree: around 40 per cent of all master's degrees are awarded in education, and in the mid-1950s this figure was nearer 50 per cent. Pure sciences, which in 1964-65 accounted for 32.6 per cent of doctorates, accounted for only 11.0 per cent of master's. A major problem in discussing the degree is its diversity. There are about 100 designations apart from the traditional (and to the outsider comprehensible) M.A. and M.Sc. regulations, and meanings vary: in some disciplines and at some institutions it may simply imply one year's extra course-work, at another it implies course-work plus a short thesis. It may be a two year professional training. It can be considered as the accolade of graduate education or the stigma of doctoral failure. So varied is it that the Dean of Graduate Studies at Harvard wrote, in the 1950's (1):

"The Master's degree is, at present, a bit like a streetwalker - all things to all men (and at different prices)."

Generally speaking, it is a terminal degree in professional fields, and may be the first professional degree in some; whereas in academic fields it is a consolation prize.

The academic master's degrees are a minority: as has already been pointed out, 40 per cent of them are awarded in education alone. In academic eyes the status of the degree has fallen as a consequence. The "great" universities are not the major producers of master's, as they are of doctorates. A large number of liberal arts colleges have begun graduate work at the master's level, and in 1960 they awarded 25,000 master's degrees (2) out of a total of about 75,000. Of these 25,000, some 14,000 were in education. A report on graduate study in liberal arts colleges suggests that they are principally concerned

(1) In the Journal of Higher Education, quoted Berelson (p. 185).

(2) Graduate Study in the Liberal Arts Colleges.

with providing teachers for secondary schools - and for themselves. In 76 out of 413 institutions the degree involved a thesis.

It is not surprising that there has been a good deal of debate over the possibility of reviving (some have said "exhuming") the master's degree in academic subjects. Berelson's comments on this possibility are worth quoting at length:

"The prospects of making the Master's a highly respected research-oriented, 1½ to 2 year degree for college teachers on a national scale are, I think, not bright. There is too much going against it: the historical decline, the lowered prestige, the diversity of meaning, the numbers of claimants relative to the numbers of faculty available for sponsorship and guidance, the competitive disadvantage relative to the doctorate, the coolness of the better colleges, the reluctance of the better students, the poorer career prospects, the low return on investment. I conclude that this clock cannot be turned back." (1)

A degree in which top universities have no interest, and which is so frequently used as a consolation prize for a failed doctoral student, cannot be revived, Berelson concludes. In professional fields the situation is, of course, rather different. It is also possible that there are types of education, appropriately offered at the master's level, in which some liberal arts colleges might specialise. Some of these might yet become "havens of respectability" for master's education in fields where an element of specialisation might usefully be grafted on to the very general first degree as suitable preparation for employment. However, in times and fields where doctoral education is easy to obtain, the hopes are slim. In times when funds for fellowships are tight, when there is a general belief in the existence of a glut of Ph.D.'s, a somewhat vocationally-orientated master's may find many takers. The sceptic may be convinced by studies which show that the average earnings of the holder of a master's in science are higher than those of the holder of a Ph.D.

There is another possible trend which is worth pointing out. This is the possibility of merging first degree and master's in some disciplines. If some institutions were to offer, say, a five year course leading, for example, to a master's degree in engineering, the graduate status of the degree would be further eroded. Those who would preserve - or revive - the degree should watch for suggestions of this kind.

(b) Professional Degrees

Graduate study in the United States includes much that in other countries is pursued at the level of the 2nd cycle or bachelor's degree: the study of law or medicine, for example. For purposes of this comparative exercise we shall not concern ourselves with first professional degrees, however long their acquisition may take.

VI. SUBSEQUENT EMPLOYMENT

In 1968, American universities awarded some 23,000 doctorates (excluding M.D., D.D., etc.), of whom about 66 per cent remained within the educational system, whether employed or receiving further postdoctoral education. Detailed information for the major fields is given in Table XXIII. In relatively few fields do as many as one third of

(1) Berelson (op. cit., p. 189).

TABLE XXIII
FIRST EMPLOYMENT OF Ph.D.s
(1968)

Subject	Post-doctoral Fellowship or Traineeship	Employment					
		Edu-cation	Industry	Govern-ment	Non-profit	Other	Unknown
BASIC SCIENCES							
Mathematics	4.5	68.7	10.2	1.9	1.0	2.5	10.9
Physics	19.2	36.6	14.6	5.6	1.6	3.2	18.9
Chemistry	28.3	21.2	36.0	1.9	1.0	3.4	7.9
Earth sciences	9.5	41.7	19.8	12.5	1.3	5.2	9.5
Biochemistry/ Physiology	46.2	25.8	5.5	4.5	3.9	4.2	9.6
Biology	21.5	52.2	2.0	5.0	2.2	3.8	12.9
Anatomy	31.4	38.1	3.6	7.3	2.8	6.3	10.1
Ecology, etc.	13.9	63.9	0.0	5.8	0.0	9.3	6.9
APPLIED SCIENCES							
Engineering	4.3	30.5	39.9	4.8	3.2	5.3	11.6
Agriculture	8.3	48.8	10.6	12.5	1.4	10.1	7.8
Health sciences	22.4	40.6	12.6	6.0	2.7	5.5	9.8
SOCIAL SCIENCES							
Psychology	10.7	49.4	3.5	13.7	6.4	4.2	11.7
Anthropology	4.5	82.3	0.0	1.3	1.3	2.6	7.8
Sociology	2.1	80.3	0.2	3.3	2.4	4.7	6.6
Economics	1.3	68.3	5.0	6.4	3.1	6.8	8.6
Political science	2.9	68.8	1.4	5.0	3.8	4.5	13.3
Business administr.	0.2	71.7	8.0	0.9	1.8	4.5	12.6
Education	0.8	80.6	0.7	3.7	3.3	2.3	8.2
ARTS, HUMANITIES							
History	0.9	85.5	0.4	2.8	0.6	2.7	6.8
English	0.6	89.9	0.1	0.1	0.6	1.8	6.6
Modern languages	0.8	86.0	0.3	0.6	1.8	2.2	8.0
Classics	0.9	80.0	0.0	0.0	2.9	4.7	11.4
Philosophy	0.7	90.0	0.3	0.7	1.4	0.3	6.2
Drama	2.7	82.6	1.5	2.3	2.3	1.5	6.6
Art, Music	1.3	83.4	0.4	0.0	1.3	2.7	10.6
Theology	0.7	68.3	0.0	0.0	17.0	0.7	13.0

doctorate recipients move straight out of the educational system: only in physics, chemistry, the earth sciences, applied sciences (especially engineering, but also agriculture, health fields), and psychology. There are, nevertheless, significant differences between fields in respect of the postdoctoral activities of those who do stay in the academic system. Consider two subject groups: biochemistry and physiology, and political science and international relations. In each case about 70 per cent of new graduates remain in the system, but whereas 68.8 per cent of political scientists obtain salaried jobs only 25.8 per cent of biochemists/physiologists do so. The rest, and the larger part, take postdoctoral fellowships, or traineeships. Table XXIII shows that the postdoctoral fellowship is exceedingly common in the natural sciences and scarcely known at all in the social sciences or humanities. In addition, the percentage of doctorate recipients who take these temporary positions is rising in almost all scientific fields; even in the social sciences it is considerably higher than it was ten years ago. The relevant data, for selected fields as well as all sciences, are given in Table XXIV.

Postdoctoral education is becoming formalised in a way that is not known in other countries, financed from Federal fellowship and research grant funds in a rather similar fashion to predoctoral education. Thus it is only in the fields which have access to such funds to any significant extent that this formalisation has taken place. There is no doubt that the natural sciences are now very significantly dependent upon the research efforts of postdoctoral students. Because of their importance and their ubiquity, the National Academy of Sciences carried out a considerable study of their distribution, work and subsequent employment (1). The growth of postdoctoral study - to an extent unknown outside the United States - is without doubt a major aspect of the employment of Ph.D.'s in America. There appear to be two schools of thought regarding its significance. There are those (including the authors of the report cited above) who regard it as a response to the increasing complexity of scientific knowledge. The period of apprenticeship before admission as a full member of the scientific community is increasing; the doctorate is no longer sufficient. On the other hand, there are those who regard the growth of postdoctoral study as a consequence of an unsatisfactory employment situation (e.g. the American Institute of Physics (2)): there are not enough suitable jobs for scientists. In the view of this group, the cut-back in Federal funds for R & D over the past two years or so has led to an inadequate number of research jobs, both inside and outside universities. Another way of putting this would be to say that Federal funds for research have catalysed a blossoming of graduate education in the sciences - because the money was available - which is out of proportion to the supply of suitable subsequent employment. The less favoured humanities, and social sciences, have not reached this mis-equilibration. [If this view is correct, however, social scientists had better beware.] The prevalence of this view, and the wide publicity given to it, led to a study of the employment prospects of doctorate recipients by the Office of Scientific Personnel of the National Research Council (3). This study surveyed recipients of the doctorate in science, social science, and engineering in 1967-68 and 1968-69, and distinguished seven categories of employment, including temporary postdoctoral fellowships, regular positions utilising the recipient's expertise, regular positions not requiring his expertise, and unemployment.

(1) The Invisible University.

(2) See Science, 168 (3931), p. 556 (1st May, 1970).

(3) Lindsey, Harmon et. al.: "Employment Status of Recent Recipients of the Doctorate", National Research Council, Science 168, pp. 930-939 (22nd May, 1970).

TABLE XXIV

PERCENTAGES OF Ph.D. RECIPIENTS TAKING TEMPORARY FELLOWSHIPS

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Physics	6.2	6.0	9.4	13.6	16.9	16.8	16.7	17.8	22.3	23.2	19.3	34.0
Chemistry	6.5	11.5	15.5	22.8	24.9	26.2	26.7	27.8	26.6	29.1	28.8	32.9
Biology	6.6	10.6	15.0	20.5	21.5	21.7	21.7	24.3	24.1	26.6	28.5	32.9
Engineering	1.7	2.0	3.4	3.0	3.9	5.4	5.5	5.5	5.0	4.4	4.6	6.2
Social sciences	1.8	3.7	4.6	5.2	5.6	5.7	5.4	6.6	6.5	6.5	6.0	7.4
ALL SCIENCE	4.5	6.8	9.6	12.7	13.8	14.0	13.7	14.9	14.9	15.7	15.4	19.3

These figures refer to all Ph.D. recipients: a larger percentage of non-Americans take these temporary fellowships (21.7%) than do Americans (13.7%).

TABLE XXV

NUMBERS AND PERCENTAGES OF RECIPIENTS OF THE DOCTORATE, BY EMPLOYMENT CATEGORY AND BY FIELD, FOR ALL U.S. INSTITUTIONS.
(THE VALUES IN PARENTHESES IN COLUMNS 1-7 ARE PERCENTAGES OF THE TOTALS GIVEN IN COLUMN 8.
THE VALUES IN PARENTHESES IN COLUMN 8 ARE PERCENTAGES OF THE TOTALS IN COLUMN 9).

Field	No. of Depts	1		2		3		4		5		6		7		8		9	
		1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969	1968	1969
Mathematics	150	14 (1.7)	43 (4.3)	47 (5.7)	44 (4.4)	18 (2.2)	20 (2.0)	725 (87.6)	854 (86.3)	3 (0.4)	1 (0.1)	7 (0.7)	21 (2.5)	20 (2.0)	20 (2.0)	825 (85.4)	989 (93.0)	970	1063
Physics	158	280 (22.9)	371 (28.1)	51 (4.2)	51 (3.9)	28 (2.3)	21 (1.6)	837 (68.3)	829 (62.8)	6 (0.5)	11 (0.8)	13 (1.0)	15 (1.2)	24 (1.8)	24 (1.8)	1225 (86.0)	1320 (90.9)	1424	1452
Chemistry	153	255 (16.4)	491 (28.4)	48 (3.1)	44 (2.5)	41 (2.6)	52 (3.0)	1136 (72.9)	1069 (61.8)	14 (0.9)	26 (1.5)	22 (1.3)	50 (3.2)	26 (1.5)	26 (1.5)	1559 (87.4)	1730 (88.9)	1784	1947
Earth Sciences	110	23 (5.6)	66 (13.8)	35 (8.5)	49 (10.3)	14 (3.4)	8 (1.7)	331 (80.3)	341 (71.5)	2 (0.5)	3 (0.6)	4 (0.8)	7 (1.7)	6 (1.3)	6 (1.3)	412 (93.8)	477 (95.0)	439	502
Engineering	456	51 (2.0)	152 (5.0)	165 (6.5)	177 (5.8)	74 (2.9)	119 (3.9)	2049 (80.5)	2346 (77.5)	3 (0.1)	13 (0.4)	53 (1.8)	193 (7.6)	166 (5.5)	166 (5.5)	2544 (89.7)	3026 (93.6)	2836	3234
Sub-total	1027	623 (9.5)	1123 (14.9)	346 (5.3)	365 (4.8)	175 (2.7)	220 (2.9)	5078 (77.3)	5439 (72.1)	28 (0.4)	54 (0.7)	32 (0.5)	286 (4.4)	242 (3.2)	242 (3.2)	6568 (88.1)	7542 (92.0)	7453	8198
Biochemistry	106	172 (42.7)	289 (59.3)	31 (7.7)	32 (6.6)	9 (2.2)	9 (1.8)	179 (44.4)	144 (29.6)	1 (0.2)	6 (1.2)	3 (0.6)	5 (1.2)	4 (0.8)	4 (0.8)	403 (70.2)	487 (89.0)	574	547
Agricultural Sciences	148	23 (3.7)	56 (8.6)	176 (28.3)	148 (22.7)	14 (2.3)	21 (3.2)	401 (64.6)	398 (60.9)	1 (0.2)	5 (0.8)	8 (1.2)	6 (1.0)	17 (2.6)	17 (2.6)	621 (91.7)	653 (80.1)	677	815
Health Sciences	169	48 (15.4)	107 (30.3)	24 (7.7)	30 (8.5)	8 (2.6)	8 (2.3)	224 (72.0)	197 (55.5)	2 (0.6)	1 (0.3)	1 (0.3)	4 (1.3)	8 (2.3)	8 (2.3)	311 (78.5)	353 (81.0)	396	436
Other Biological Sciences	510	378 (19.5)	716 (34.0)	153 (7.9)	141 (6.7)	37 (1.9)	33 (1.6)	1316 (67.8)	1158 (55.0)	10 (0.5)	18 (0.9)	25 (1.1)	21 (1.1)	17 (0.8)	17 (0.8)	1940 (95.3)	2106 (90.9)	2036	2318
Sub-total	933	621 (19.0)	1168 (32.5)	384 (11.7)	351 (9.8)	68 (2.1)	71 (2.0)	2120 (64.7)	1897 (52.7)	14 (0.4)	30 (0.8)	36 (1.0)	36 (1.1)	46 (1.3)	46 (1.3)	3275 (88.9)	3599 (87.4)	3683	4116
Psychology	96	62 (6.8)	112 (10.4)	12 (1.3)	28 (2.6)	21 (2.3)	18 (1.7)	747 (81.5)	844 (78.4)	1 (0.1)	1 (0.1)	12 (1.1)	62 (6.8)	62 (5.8)	62 (5.8)	917 (63.0)	1076 (62.3)	1456	1728
Other Social Sciences	274	22 (1.6)	31 (2.1)	117 (8.8)	122 (8.3)	3 (0.2)	26 (1.8)	1138 (85.2)	1225 (83.1)	9 (0.7)	7 (0.5)	5 (0.4)	42 (3.1)	53 (3.6)	53 (3.6)	1336 (47.0)	1474 (46.4)	2842	3177
Grand Total	2330	1328 (11.0)	2434 (17.7)	859 (7.1)	866 (6.3)	267 (2.2)	335 (2.4)	9083 (75.1)	9405 (68.7)	52 (0.4)	91 (0.7)	81 (0.7)	426 (3.5)	403 (2.9)	403 (2.9)	12096 (78.4)	13691 (79.3)	15434	17219

Department chairmen were asked to give the employment distribution of their Ph.D. graduates for each of the previous two years as of the date of reply. The bulk of the relevant information is given in Table XXV. The authors report a situation more of hysteria than of crisis. Their figures, they consider, demonstrate that virtually all recipients of doctorates obtain relevant positions, both the percentages having to take jobs not requiring the knowledge they have acquired and the percentages totally unemployed are virtually negligible. However, the comments received from respondents (i.e. heads of departments) suggested that many academics consider that a crisis situation exists. So far as postdoctoral fellowships are concerned, the survey is nevertheless inconclusive. Even if the employment situation is in balance with the production of Ph.D.'s, it is now clear that this is not a consequence of the large number of postdoctoral fellowships available. The authors admit that their study does not illustrate the extent to which these fellowships have been used as a substitute for permanent employment (1).

Another aspect of the employment of Ph.D.'s which deserves attention here is subsequent job mobility. This has been analysed in two studies of 1935-1960 Ph.D. recipients carried out by the N.A.S. for the National Institute of Health (2). [Samples were artificially weighted in favour of bio-sciences, to take account of the particular interests of the sponsors.] The tables given below relate to field change and sector of employment change but do not make any attempt to review the question in depth, or to touch upon changes in employment function - e.g. research/non-research - which are of great importance. (Cohorts in Table XXVI refer to period of graduation: "1" representing 1935 graduates, "66" representing 1960 graduates.)

VII. GRADUATE EDUCATION NOW, AND POLICIES FOR REFORM

If this report has accurately reflected its subject matter, then it should have given a picture of an educational system unequalled in its variety and flexibility. Some 30-40 per cent of American youth receives higher education, and perhaps 20 per cent of the men and 7-8 per cent of the women stay for yet more education, whether professional (as it is for most) or in an intellectual discipline. It is almost possible in America to talk of percentages of this or that age group receiving graduate education. Because of the openness and flexibility of the American university, to which Ben-David has drawn attention (3), much is found in the American university which the European university would reject. Much professional education, which in Europe would be extra-mural, in the United States has found a home within the college or university. Thus a good deal of American graduate education cannot strictly be included if American and other systems are to be compared. This is less true at the doctoral level; and in the more academic subjects it is this degree which is the ultimate goal of most of those who embark upon graduate study. Thus, in chemistry, as in sociology and in philosophy, the master's degree is rather discredited. We have suggested that in the School of Science and Art - if not in the Professional School - the master's degree can no longer be regarded as an objective in its own right. American graduate education has expanded rapidly in post-war

- (1) p. 933. It is not correct, however, to compare the 1968 and 1969 figures in Column 1 of Table XXV. This apparent increase derives from the fact that the employment of both (1968 and 1969) groups of graduates in January 1970 was studied. Many of the first group would by then have finished their one year postdoctoral awards.
- (2) L.R. Harmon: Profiles of Ph.D.'s in the Sciences (N.A.S.-N.R.C. 1965)
" " Careers of Ph.D.'s - Academic versus Non-Academic (N.A.S.-N.R.C. 1968).
- (3) J. Ben-David: Fundamental Research and the Universities (OECD, 1968).

TABLE XXVI

NUMBER OF Ph.D.'s. SHIFTING EMPLOYER CATEGORIES, BY COHORT AND TIME PERIOD

Cohort	Time Period of shift	Academic(A)			Business(B)			Government(G)			Other(O)			Un- known	Net Change			
		to			to			to			to				A	B	G	O
		B	G	O	A	G	O	A	B	O	A	B	G					
1	1935 to 1940	19	36	46	24	3	13	3	11	2	41	7	6	58	-25	-12	+29	+8
	1940 to 1945	37	51	143	11	12	8	16	9	6	26	6	6	54	-185	+21	+31	+133
	1945 to 1950	16	16	34	20	3	3	17	30	13	120	10	24	36	+104	+8	-17	-95
	1950 to 1955	10	6	29	2	2	4	11	5	3	20	8	5	27	-14	+14	-9	+9
	1955 to 1960	7	2	20	7	2	7	7	5	2	19	4	6	26	+2	-	-4	+2
1960 to 1963	3	2	19	6	5	7	5	3	3	2	32	4	4	24	+17	-9	+1	+9
2	1940 to 1945	72	62	234	20	10	24	28	14	3	30	8	14	73	-304	+29	+41	+234
	1945 to 1950	25	21	44	32	15	16	12	47	15	194	38	38	75	+183	+24	-9	-198
	1950 to 1955	24	22	41	13	10	10	6	10	10	22	11	10	48	-42	+22	-6	+14
	1955 to 1960	8	11	24	16	15	15	10	15	7	23	7	5	37	+11	-9	-16	+14
	1960 to 1963	4	3	19	9	1	10	6	6	7	32	12	15	31	+21	+3	-	-24
3	1945 to 1950	32	25	60	34	6	4	15	25	1	49	5	7	39	-9	-6	-3	+18
	1950 to 1955	27	20	54	6	1	7	8	6	7	21	7	5	40	-68	+27	+5	+36
	1955 to 1960	12	8	29	8	5	6	5	7	2	34	6	5	33	-	+1	+4	+5
	1960 to 1963	9	6	30	18	2	5	1	5	2	47	4	9	22	+25	-10	+9	-24
	1950 to 1955	55	40	82	17	6	4	9	13	10	41	22	11	57	-106	+60	+25	+21
1955 to 1960	31	21	45	14	2	5	10	16	10	46	14	3	56	-21	+34	-10	-3	
1960 to 1963	9	10	30	15	4	8	8	10	3	38	14	7	28	+14	+2	-	-16	
5	1955 to 1960	39	35	66	35	2	16	8	36	15	76	21	11	89	+7	+22	-11	-18
	1960 to 1963	13	22	35	18	3	9	9	10	3	45	8	15	84	+3	-6	+18	-15
6	1960 to 1963	42	27	62	30	6	7	5	28	11	69	14	19	30	-4	+24	+8	-28

TABLE XXVII

FIELD-SWITCHING FROM DOCTORATE DEGREE TO 1962 JOB,
NUMBERS OF CASES, TOTAL GROUP

Field of Doctorate	Physiology	Pharmacology	Biochem.	Micro.	Botany	Genetics	Zoology	Misc. Bio.	Agriculture	Med. Science	Socio. Science Total	Physical Science Total	Arts and Prof.	Total
Physiology	275	20	29	8	2	2	18	21	28	96	1	17	16	533
Pharmacology	2	72	2					3		40	1	21	4	152
Biochemistry	22	22	383	17		5	1	10	47	41		115	21	684
Micro.	17	1	23	351	6	4	2	12	16	35		32	11	510
Botany	61	2	8	26	192	26	2	41	37	11		11	19	443
Genetics	9		3	3	7	73	2	9	39	3		1	5	154
Zoology	99	4	9	17	5	8	244	72	16	22		10	16	522
Misc. Biology	22	1	9	6	8	2	14	62	6	8	1	10	3	152
Agriculture	14	1	14	3	12	14	6	4	397	5	10	41	22	533
Medical Science	11	7	6	10			3	4	1	188		17	7	254

	Bio-Science Total	Psychology	Sociology	Economics	Pol. Sci.	Hist. Geogr.	Math.	Physics	Chemistry	Geology	Engin.	Lang. and Litt.	Arts and Hum.	Prof.	Educ.	Total
Psychology	12	372	2		1	2	4		8		2	5		10	42	467
Sociology	6	13	314	4	8	16			8		1	4	11	35	24	444
Economics	4	3	1	315	6	2	8		3		1		1	76	15	435
Political Science	1		2	14	286	16			7			2		26	22	376
History/Geography		1		4	15	347		2	4	2		9	6	23	34	447
Mathematics	4			1			404	4	4	1	20			4	14	456
Physics	12				2		11	335	14	5	44			6	5	434
Chemistry	32	1					2	12	374	5	32			26	7	491
Geology	6			1			6	5	3	387	10			4	7	431
Engineering	2	1				2	5	8	15	5	402			13	8	459
Language and Literature	1	2			2	3	1		5		1	376	15	18	31	455
Arts and Humanities	5	6	4	1	3	3	3		3			28	263	31	27	377
Prof.	3	9	4	22	8	13	1		1			3	14	264	21	363
Education	5	30	4	2	1	5	9	2	5			8	7	17	292	394

years - much faster than bachelor's education - and this has largely been brought about by Federal funds. More money for academic science has meant more money for fellowships and more money for graduate research assistantships. The great applied science and technology programmes have vastly boosted industry's need for students to seek an education to research level in the sciences. As a consequence, patterns of finance of graduate studies in the sciences and technologies have diverged sharply from those in other fields. For example, far more students are supported from Federal funds in the scientific subjects; far fewer from institutional funds. This has meant that fewer of the best students have taken the (more irksome, for the research-minded) teaching assistantships, and fewer of the best students teach undergraduates. Since faculty do relatively little teaching either, at the undergraduate level in the top institutions students of science are taught by the less brilliant graduate students. In the past year or two, Federal funds for academic science have begun to decline - fewer fellowships, fewer research assistantships. There has been talk of major agencies, such as N.I.H., switching from fellowship programmes to loan programmes of graduate student support. In a climate of expanding demand for Ph.D.'s on the part of employers, this may not have drastic effects. At the present moment this is not the case in the sciences. Although there is conflicting evidence as to whether there is an over-supply of scientific Ph.D.'s (as we have indicated), no one would suggest that there is anything approaching a shortage. Yet, it is only in conditions of shortage that the sacrifice of high earnings and the acceptance of loan-finance will look interesting. At the present moment, whatever the real employment situation, it is widely believed that employment is hard to find for the Ph.D.

Under these conditions it is not the elite institutions which will suffer but the most important second rank. Federal retrenchment could wreak havoc among the average public universities, so far as their research programmes are concerned. It may be objected that research students have been shown to carry out a relatively small percentage of all academic research. But these students contribute significantly to the teaching in research-performing institutions, as well as to the research. Fewer graduate students will mean less research, or less teaching - we cannot be sure which. If, in the light of the nation's research effort through the 1970s, less Ph.D.'s are in fact needed (as a proportion of the number graduating), what then? It may be that full doctoral employment now results only from the recent expansion of postdoctoral education. Because such posts are not permanent jobs they do not imply an economic demand, and it is to be doubted whether a real demand for Ph.D.'s on the scale of their present production really exists. However, this is a technical matter deserving proper quantitative treatment. Blank and Stigler have already provided a methodology which might be applied (1). Nevertheless, one can anticipate a demand for a different kind of higher graduate. If, as some believe, great programmes of socio-technological innovation are to be the new incentives to progress, replacing the weapons-dominated programmes we have today, there may be need of a new man. He will be a specialist by virtue of his combinations of expertise: civil engineering and sociology, or mechanical engineering and psychology. If this happens, the demands for the restitution of the master's degree may begin again.

Of course, all this has to be paid for in one way or another, and on one scale or another. What role should the Federal government play in the finance? In many federally administered countries this becomes a problem. In America, as in Switzerland, Canada and Germany, education is traditionally a state responsibility (a jealously guarded one

(1) D.M. Blank and G.J. Stigler: The Demand and Supply of Scientific Personnel (New York, 1953).

in some instances), whilst the support of academic research has come in all cases to depend upon some central source or sources. Graduate education, especially at the research level, has elements of both education and research. Consequently, discussion of the role appropriate to the federal authorities in the finance of graduate education has become an important issue in all these countries, the United States included. Should federal agencies only finance research, with the support of students as research assistants as spin-off? This battle was lost and won in the 1950s with the National Defense Education Act, and the institution of N.S.F. fellowships. These fellowships support individuals, and the former helps the non-science disciplines too. But in science most students receiving Federal support still do so in the form of research assistantships. Everyone accepts Federal support of graduate education, but there is still dispute over the appropriate beneficiary: the discipline? the institution? the individual? On this, it is worth quoting a fairly recent policy statement of the National Science Board (which is the policy-making governing body of the N.S.F.) (1). In recommendations to the Federal authorities, the N.S.B. recommended specific appropriations for graduate education (in its own name) from Congress to supplement, not replace, funds available from other sources. Funds should be available to all institutions offering graduate education, whether it is the great university or the small college offering only the M.Ed. The Report goes on to propose a mechanism of support for Federal funding of graduate science education, made up of six programmes.

1. Institutional Support to be used by selected institutions as they wish, the amounts to be determined by an appropriate formula.
2. Departmental Sustaining Grants awarded competitively to departments on the basis of quality, and to include funds to be used as graduate student stipends. Such support would be appropriate equally to multi-disciplinary programmes.
3. Developmental Grants, principally to help initiate new graduate programmes, where these would be of value.
4. Graduate Facilities Grants, for (e.g.) libraries and other physical plant.
5. Graduate Fellowship Scheme (as it is now known) should be maintained to the extent of 1-2 per cent enrolment in graduate schools.
6. Research Project Grants - also to continue, but would henceforth support a much smaller percentage of students.

There must therefore be a more unified, guaranteed programme of support for graduate education as such, for the products of graduate education must be viewed as a national resource. A more recent report of the President's Task Force on Science Policy (2) explicitly supports the recommendations of the N.S.B. Moreover, as the Federal administration cuts down on its support for research education programmes, talk of a much larger scale Federal subvention of higher education in general is revived. Indeed, in 1970 President Nixon proposed a "national foundation for higher education" in a message to the Congress. This was subsequently embodied in a Bill introduced by Rep. Albert Quie (HR 16622, Higher Education General Assistance Act of 1970) in March 1970. This

(1) National Science Board: Towards a Public Policy for Graduate Education in the Sciences (N.S.B. 69-1).

(2) "Science and Technology: Tools for Progress", Report of the President's Task Force on Science Policy (April 1970), pp. 29-30.

Bill, however, ran into some trouble, largely on account of dislike of the institutional support clause. The issue is far from dead. Perhaps one word of caution is appropriate. The mechanism of support proposed is only half a policy: surely the determination of the level of support is the complementary half? Is this to be based upon national requirements for specialists? If so, the very flexibility of American education may prove a barrier. Need-controlled education, as distinct from social demand-controlled education, may be hard to accept. Secondly, because of the innumerable sources of support open to graduate students, the Federal government will surely find that it is in no position to force supply and demand into equilibrium. The agency responsible for graduate education will surely find that the great technology agencies (N.A.S.A., D.O.D., etc.) continue to influence the demand for specialists - and thence, perhaps, the demand for places at graduate school - more than they do themselves. But this will only add one more set of interactions to the "many body problem" that is American government.

SOURCES OF TABLES

TABLE I	Berelson (1960), p. 26.
TABLE II	N.S.B. (69-2), Table I-5, p. 32.
TABLE III	Consolazio (67), Table C5, p. 171.
TABLE IV	1900-1940: Berelson (1960), p. 26; 1950-1964, OECD (DAS/EID/69.27/07).
TABLE V	1951 Wolfle (1954), Tables IV-1 and IV-2, pp. 52-4 1958 Scientific and Technical Manpower Resources, N.S.F. (64-28), Table V-22, p. 148.
TABLE VI	<u>Profiles of Ph.D.'s in the Sciences</u> N.A.S. (1293), Appendix 8, pp. 92-94.
TABLE VII	E. Bacon "Report on Federal predoctoral student support", unpublished report, Federal Interagency Committee on Education, 1970; cited York (<u>Science</u> , 172, p. 647, 1971).
TABLE VIII	<u>Graduate Student Support and Manpower Resources</u> N.S.F. (70-40), Table C7.
TABLE IX	<u>Graduate Student Support and Manpower Resources</u> N.S.F. (68-13), Tables Va, Vb, pp. 51-2.
TABLE X	<u>Graduate Student Support and Manpower Resources</u> N.S.F. (70-40), Table C11a
TABLE XI	N.S.F. (68-13), p. 32.
TABLE XII	Estimation from OECD statistics (<u>loc. cit.</u>).
TABLE XIII	Wolfle (1954), p. 298 and OECD (<u>loc. cit.</u>).
TABLE XIV	N.S.F. (64-28), Table V-22, p. 148.
TABLE XV	N.S.F. (64-28), Table V-24, p. 150.
TABLE XVI	<u>Doctorate Recipients from United States Universities</u> , 1968, N.R.C. (April 1969), Table 2.
TABLE XVII	N.S.B. (69-2), Table 1-3, p. 24.
TABLE XVIII	Berelson (<u>loc. cit.</u>), p. 159.
TABLES XIX XX	C.R. Wright <u>Sociology of Education</u> 38 (1964), p. 73 et seq.
TABLE XXIII	<u>Doctorate Recipients from United States Universities</u> , 1968, N.R.C. (April 1964), Table 2.
TABLE XXIV	L.R. Harmon et. al. <u>Science</u> , 168, p. 934 (22nd May, 1970), Table 3.
TABLE XXV	Harmon et. al. (<u>loc. cit.</u>) Table 2, p. 932.
TABLE XXVI	<u>Careers of Ph.D.'s</u> N.A.S. (1577) Table 2, p. 8.
TABLE XXVII	<u>Profiles of Ph.D.'s</u> N.A.S. (1293) Table 26, p. 51.

BIBLIOGRAPHY

MAJOR SOURCES CONSULTED

- Berelson, B.: Graduate Education in the United States (McGraw Hill, 1960)
- Carmichael, O.G.: Graduate Education (Harper N.Y., 1961)
- Consolazio, W.V.: The Dynamics of Academic Science (N.S.F., January 1967, N.S.F. 67-6)
- NATIONAL ACADEMY OF SCIENCES/NATIONAL RESEARCH COUNCIL:
- Profiles of Ph.D.'s in the Sciences (1965)
- Careers of Ph.D.'s - Academic vs Non-academic (1968)
- Doctorate Recipients from United States Universities. Summary Report 1968 (1969).
- NATIONAL SCIENCE BOARD:
- Toward a Public Policy for Graduate Education in the Sciences (N.S.B. 69-1)
- Graduate Education - Parameters for Public Policy (N.S.B. 69-2)
- NATIONAL SCIENCE FOUNDATION:
- Graduate Student Enrollment and Support in American Universities and Colleges (1954)
- Scientific and Technical Manpower Resources (1964)
- Graduate Student Support and Manpower Resources in Graduate Science Education (1968)
- National Patterns of R & D Resources 1953-70 (1969)
- Annual Report for 1969 (70-1)
- Graduate Student Support and Manpower Resources in Graduate Science Education (1969)
- OECD: Development of Higher Education 1950-1967, Statistical Survey (OECD, 1970)
- OECD: Survey of Resources Devoted to R & D in 1967: Vol. IV (DAS/SPR/70.6) (OECD, 1970)
- Orlans, H.: The Effects of Federal Programs on Higher Education (Brookings, 1962)
- Orlans, H. (ed.): Science Policy and the University (Brookings, 1968)
- SCIENCE:
- Nixon Budget: Science Funding Remains Tight, 6th February, 1970, p. 845
- N.A.S.A. Further cuts in University Support Spending, 20th February, 1970, p. 1107
- L.R. Harmon et.al.: Employment Status of Recent Recipients of the Doctorate, 22nd May, 1970, p. 930
- Federal Graduate Aid - Down But Not Out, 26th June, 1970, p. 1559
- Wolfle, D: America's Resources of Specialized Talent (Harper, N.Y., 1954)

- Wright, C.R.: "Success or Failure in Earning Graduate Degrees", Sociology of Education 38 (1964), p. 73
- York, Carl M.: "Steps Towards a National Policy for Academic Science", Science, 172, (May 1971), pp. 643-8

PROBLEMS OF POSTGRADUATE EDUCATION

PROBLEMS OF POSTGRADUATE EDUCATION IN DEVELOPING MEMBER COUNTRIES

TABLE OF CONTENTS

	<u>Page</u>
I. <u>GENERAL DISCUSSION</u>	297
II. <u>GREECE</u>	298
(a) The Greek University System.....	298
(b) Research and Postgraduate Education.....	300
(c) Postgraduate Education and Manpower Needs.....	301
III. <u>TURKEY</u>	304
(a) The Turkish University System.....	304
(b) Postgraduate Education.....	306
(c) Postgraduate Study Abroad.....	307
(d) Postgraduate Education and Manpower Needs.....	307
SOURCES OF TABLES.....	309

I. GENERAL DISCUSSION

The preceding analysis has dealt exclusively with the problems of the industrialised Member countries. In this study we attempt briefly to draw attention to the rather different problems faced particularly by the Mediterranean countries. Parts II and III focus specifically upon Greece and Turkey; and it is upon the situations in these countries that we shall concentrate implicitly.

The majority of universities in less industrialised Member countries are characterised by:

- (i) high student/staff ratios;
- (ii) out-dated curricula;
- (iii) enormous pressure of demand for places;
- (iv) slight research effort, generally carried out by isolated groups of one or two.

Decision-making structures, whether or not they allow the university a high degree of autonomy (as in the traditional German model, adopted in Greece and Turkey), concentrate power in a few hands. The pressure acting against any innovation is strong. For example, a Chair holder who does no research and is effectively out of touch with his subject is unlikely to welcome the appointment of a highly research-minded young lecturer to his department or institute. The comparison would hardly be to his credit. Given the difficulties of innovation, given also the enormous pressure of demand for places at the first cycle level - whatever the quality of the education - it is not surprising that postgraduate education has not been a very high priority for policy-makers. Indeed, it is impossible to discuss it in isolation from these more general problems. On the other hand, universities have to be staffed, and it is by gradually filling them with research-minded teachers that general standards can be improved. It is true that the necessary personnel can be obtained by sending first cycle graduates abroad for training; this is certainly cheaper per capita (1). Yet there are disadvantages in relying upon such a procedure other than in the short-term. The creation of first one, and then more, graduate schools could have a much more impressive effect upon general academic standards; the fields of specialisation could reflect the real needs of the developing economy, including of course those of the growing universities. A centre of academic excellence could help to attract high calibre expatriates, who might indeed even provide its staff in the short-term.

The establishment of M.Sc.-type courses, aimed at offering increased specialisation to graduates not necessarily embarking upon a research career, is also worthy of consideration.

There could be value in the preparation of detailed plans for the establishment of graduate schools in Mediterranean Member countries. Clearly, however, such studies would need to take account of (a) the likely demand, as well as need, for their products and (b) the problems, financial and organisational, involved in the implementation of plans.

(1) For some countries, and especially in the natural sciences, more doctorates have been awarded to nationals in the United States than in home universities. Table I gives the number of United States Ph.D.'s awarded to students who had received their first degrees in Mediterranean countries, for 1950-59 and 1960-61, and for five major fields.

TABLE I
UNITED STATES DOCTORATES BY BACCALAUREATE ORIGIN AND BY FIELD
1950-1961

		Physical Sciences	Biological Sciences	Social Sciences	Arts and Professions	Education	Total
Greece	1950-1959	32	25	13	14	7	91
	1960-1961	15	11	3	3	1	33
Italy	1950-1959	21	7	8	25	2	63
	1960-1961	4	5	1	9	-	19
Portugal	1950-1959	1	5	1	1	-	8
	1960-1961	-	1	-	-	-	1
Spain	1950-1959	9	4	4	14	2	33
	1960-1961	7	1	1	4	-	13
Turkey	1950-1959	33	7	12	5	3	60
	1960-1961	10	4	4	5	4	27

II. GREECE

(a) The Greek University System (1)

There are two large universities in Greece, at Athens and Salonika, organised along traditional German lines. That is, they are public and autonomous, governed by a rector, who is elected annually, and a senate, yet delegating a good deal of power to Chair holders. Professors thus enjoy complete control over such matters as appointments, curricula, teaching arrangements, and the organisation of research institutes. In addition to Athens and Salonika Universities there are a number of other university-level institutions, including the Metsovion Polytechnics (Athens), the College of Commercial and Economic Studies, the Agricultural College of Athens, the Panteios College of Political Science, Industrial Colleges at Salonika and Piraeus, and National Colleges of Fine Arts and Gymnastics. Since 1966 there has also been a university at Patras. None depart significantly, in terms of their methods of government, from the traditional pattern. The student/teacher ratio in university-level institutions is very high in Greece - over 46:1 in 1963-64. In the University of Salonika it was over 60:1, and in the School of Physical Sciences of Athens University about 100:1. The pressure of demand for places is exceedingly large, and a relatively small percentage of those qualified succeed in gaining admittance at their first attempt. Nevertheless, the student/teacher ratios are deteriorating as some attempt is made to keep up with demand (2). An obvious consequence is a considerable prolongation of studies over the legal minimum, a high wastage rate and a pronounced tendency to seek higher education abroad. The extent to which Greek students do migrate in search of their education is demonstrated by Table II.

(1) This section draws extensively upon George Haniotis: "The Situation of the Universities in Greece", Minerva VI (2) 1968.

(2) See Mediterranean Regional Project: Greece (OECD, 1965), Table 32.

TABLE II
GREEK STUDENTS ABROAD: DISTRIBUTION BY LOCATION
AND BY AREA OF STUDY (1961)

Country of Study	Total No. of Greek Students	% Studying Science or Technology	% Studying Humanities or Social Sciences
Austria	2,450	70.9	29.1
Germany	2,130	60.9	39.1
Italy	1,420	63.6	36.4
United States	1,200	48.4	51.6
France	600	25.8	74.2
Switzerland	500	43.1	56.9
Others	500	51.0	49.0
Total	8,800	58.8	41.2
Percentage of all Greek students in each area of study who are abroad	24.0	33.2	17.0
	(All)	(Science/Technology)	(Humanities/Social Sciences)

By 1966 this total had fallen to 6,600, of which 75 per cent were studying scientific and technological subjects, compared with 58.8 per cent in 1961 (1).

The distribution by disciplines in university-level institutions in 1966-67 was as follows.

PERCENTAGE DISTRIBUTION BY DISCIPLINE (1966-67)

<u>Science</u>	<u>Technology & Architecture</u>	<u>Medical Subjects</u>	<u>Agriculture</u>	<u>Humanities and Arts</u>
12.1	8.5	15.9	5.7	12.8
	<u>Social Sciences</u>	<u>Law</u>	<u>Education</u>	<u>Others</u>
	31.4	12.9	0.7	0

Thus, some 42 per cent of students were studying scientific, technological, medical and agricultural subjects. In that year some 2,500 students graduated from the universities in these fields. But the level of qualification which this represented is acknowledged to be low. As Haniotis put it:

(1) Haniotis (loc. cit.), p. 169.

"Syllabi for most of the courses taught within the Greek institutions of higher learning are inadequate in their intellectual quality, outmoded and unenlightened by contemporary European and American standards."

Textbooks available in Greek are out of date and there was no incentive to write new ones until recently when the Government required the professors to write new ones. The authors of the M.R.P. Report were in agreement that curricula were not suited to the modern university.

The authors of the Pilot Team study (1) wrote:

"Perhaps the most striking indication of weakness in the quality of university education is the fact that Greek graduates enrolling for postgraduate studies abroad find themselves in considerable difficulty in the first period of graduate studies. They often have to attend first cycle lectures in order to acquire an adequate foundation for their postgraduate work."

(b) Research and Postgraduate Education

There is no formal postgraduate education in Greek universities, although doctoral degrees are awarded on the basis of a successfully defended dissertation (see below). There has been one recent attempt to circumvent the inertia of the universities, but this failed. Between 1962 and 1964, the Greek Atomic Energy Commission organised a Centre for Advanced Physical Studies and Philosophy of Science, based on the Democritus Centre. A programme of lecture courses, plus research, would have led to the Ph.D. This was to have been conferred by the Weitzman Institute of Israel since in Greece only universities may give degrees. In 1964, a new Board of Directors of the Greek A.E.C. suspended the programme.

In spite of this, some 200 or so doctorates are awarded annually in Greece. The numbers in each discipline in 1962-63 and 1966-67 are shown below:

TABLE III

DOCTORATES AWARDED IN GREECE (1962-63 AND 1966-67)

	<u>1962-63</u>	<u>1966-67</u>
Science	13	13
Technology and Architecture	7	12
Medical subjects	169	138
Agriculture	7	4
Humanities and Arts	8	16
Social science	2	3
Law	3	6
Education	0	0
Total	209	192

In other words, 70-80 per cent of all doctorates are awarded in medicine; scarcely any in natural, social or applied sciences. The few who do work towards their doctorates in these fields do so in a climate which is far from research-oriented. Professors,

(1) "Science and Development - Greece" (OECD, 1968), p. 125.

having life-time security of tenure, are not motivated to conduct research. As Haniotis puts it (loc. cit., p. 175): "No one threatens him with such naive slogans as 'publish or perish'; he is not judged by academic or scientific criteria". Far more likely, he spends such free time as he has available on lucrative consultancies or on official committees, subsidiary occupations being regarded as appropriate for Chair holders. So far as the occupants of more junior positions are concerned, they do not have access to these supplements to their incomes. Their incomes are so low, however, that the better graduates are not prepared to take such academic posts. As the Pilot Team reported: "As a result, a large number of instructor or assistant posts are held by people who have no research experience and only a very limited knowledge of the subjects they are teaching" (p. 126). There is in fact very little actual research in the natural sciences in the universities. The Pilot Team estimated that of 227 laboratories in the Universities of Athens and Salonika, the Metsovion Polytechnic and the College of Agriculture, only 139 carried out any research. Of these, only 41 contained 4 or more research workers (26 in the University of Athens). Excluding medical research, and introducing a criterion of minimum necessary finance, only 8 research units qualified (p. 130).

(c) Postgraduate Education and Manpower Needs

Writing in 1965, the Greek M.R.P. team estimated the number of new teachers needed in higher education between 1962 and 1974. Taking account of the anticipated expansion of the universities, and assuming an improvement in the student/staff ratio (which was to attain 1:20 in social sciences/humanities, 1:7 in sciences, 1:5 for polytechnics by 1979), the Committee calculated that about 2,200 new teachers would be needed. Of these, 750 would be in the humanities and social sciences, 1,470 in the natural and applied sciences (1). The M.R.P. Report did not specify the need for the introduction of second and third cycle educational levels in order to meet this need. The Pilot Team was rather more explicit on this point. In order that there be the general improvement in the quality of university instruction which has been widely called for, new university teachers must be trained in research. The Pilot Team also calculated a very substantial need for scientific research workers in other sectors of the economy. Their forecast is given in Tables IV and V.

All these research workers require training to Ph.D. level, and the Pilot Team Report considered the alternatives by means of which this might be done (2):

- (i) by retaining the system whereby the doctorate is awarded simply on the basis of research carried out, wherever and however;
- (ii) by creating graduate schools on the North American model;
- (iii) by sending graduates abroad for training.

The Team chose alternative (ii). This is in spite of the fact that the per capita cost of training is estimated at double that of sending them abroad - and this is presumably the marginal cost. The reasons given for preferring indigenous graduate schools as a means of meeting manpower targets include:

- (1) losses due to emigration and failure are estimated at 11 per cent as against 20 per cent of those who are educated abroad;

(1) M.R.P. Report (op. cit.), p. 172.

(2) "Science and Development - Greece" (OECD, 1968), pp. 168-170.

TABLE IV
RESEARCH PERSONNEL AND ANNUAL NEEDS
1966-75
(GREECE)

T = Total number of research personnel
N = Annual needs in research personnel

Sector	Total		1966		1967		1968		1969		1970		1971		1972		1973		1974		1975	
	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N	T	N
Total	4100	3569	1147	186	1314	192	1533	244	1918	444	2368	522	2780	483	3189	473	3496	352	3814	352	4100	321
I. General Government Sector	1108	721	446	56	496	54	567	67	635	68	706	71	785	80	868	83	948	82	1029	81	1108	79
A. Agriculture	512	309	220	17	242	22	277	35	313	36	351	38	369	36	423	34	454	31	484	30	512	28
B. Ministerial Research Units	195	163	46	11	58	12	70	12	82	12	94	12	110	16	131	21	152	23	174	22	196	22
C. Independent Legal Entities	400	249	180	28	200	20	220	20	240	20	261	21	286	26	314	28	342	28	371	29	400	29
II. Institutions of Higher Education	1942	1895	564	90	638	95	709	100	890	240	1088	270	1278	260	1484	270	1631	190	1787	190	1942	190
A. University of Athens	456	401	156	17	176	23	194	21	212	25	255	57	312	81	354	51	383	38	420	44	456	44
B. University of Salonika	786	730	258	40	293	43	324	42	357	45	428	96	512	112	603	122	662	76	723	77	786	77
C. National Technical University of Athens	452	488	127	31	144	26	162	32	163	10	184	40	230	66	295	88	349	69	401	63	452	63
D. Higher Agricultural School of Athens	59	51	23	2	25	3	29	5	30	4	34	8	37	1	43	9	48	7	54	6	59	6
E. University of Patras	189	225	-	-	-	-	-	-	128	156	187	69	187	2	189	-	189	-	189	-	189	-
III. Business Enterprise Sector	868	818	80	30	113	33	180	67	306	126	477	171	604	127	706	102	767	61	829	62	868	39
A. Mining, Quarrying and Saltworks	55	55	3	3	7	4	11	4	31	20	39	8	42	3	45	3	48	3	51	3	55	4
B. Manufacturing	662	619	65	17	87	22	137	50	222	85	349	127	457	108	539	82	590	51	637	47	662	25
C. Electric Power	83	81	6	4	10	4	14	4	22	8	46	24	51	5	56	5	62	6	73	11	83	10
D. Construction and Public Works	54	54	2	2	4	2	12	8	23	11	33	10	43	10	54	11	54	-	54	-	54	-
E. Telecommunications	14	14	4	4	5	1	6	1	8	2	10	2	11	1	12	1	13	1	14	1	14	-
IV. Non-profit Sector	182	135	57	10	67	10	77	10	87	10	97	10	113	16	131	18	150	19	169	19	182	13

Note: Total needs of new researchers = 3,569
 Researchers needing retraining = 94
 Total needs for educational purposes = 3,663

TABLE V

ANNUAL NEEDS OF RESEARCH PERSONNEL
BY AREA OF SPECIALISATION

1966-75

(GREECE)

Area of Specialisation	Total (1)	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
TOTAL	3,569 (1)	186	192	244	444	522	483	473	352	352	321
Engineering	1,441	69	72	98	193	224	204	193	135	134	119
Scientific	1,120	54	56	74	141	179	155	149	106	108	98
Agricultural	383	24	24	28	44	47	47	49	40	40	40
Biomedical	625	39	40	44	66	72	77	82	71	70	64

Note: (1) Total needs of new researchers = 3,569

Researchers needing retraining = 94

Total needs for educational purposes = 3,663
=====

- (ii) graduate school activity will strengthen undergraduate teaching;
- (iii) indigenous research capability will stress disciplines of relevance to the Greek economy, which may not be the case when graduates are trained abroad;
- (iv) the finance of study abroad is a drain on foreign currency reserves;
- (v) graduate schools will provide centres of scientific excellence, which might attract back very highly qualified expatriates.

Proposed graduate schools could be based upon the Universities of Salonika and Patras, as well as upon the complex of academic and research institutions in the Athens area. The importance of utilising the educational potential of existing non-university research facilities is emphasized. The magnitude of the effort which the Team thought necessary is shown by Table VI.

TABLE VI
(PILOT TEAM) PROJECTIONS BY FACULTY 1969-1973:
AVERAGE No. OF GRADUATE STUDENTS

Faculty	Total Number of New Entrants Per Year	Number of New Entrants for M.Sc.	Number of New Entrants for Ph.D.	Total Number of Graduate Students
Physical sciences	452	287	165	1,234
Agriculture	127	81	46	346
Veterinary medicine	35	22	13	96
Medicine	243	155	88	662
Engineering	243	155	88	662
TOTAL	1,100	700	400	3,000

To some extent the arguments put forward by the Pilot Team are applicable also to the humanities and social sciences. In 1962, the M.R.P. Team estimated a need for 750 new teachers of these subjects in higher education between 1962 and 1974. And yet, their projections of student numbers for 1974 were more than passed by 1966-67. For example, the enrolment forecast in social sciences, excluding law, was 13,450 by 1974. The 1966-67 enrolment was 19,174. Clearly, there is an important need here, too, for qualified teachers, and the importance of a properly trained corps is no less than in the physical sciences. A good case can be made for at least one high quality graduate school in these disciplines.

III. TURKEY

(a) The Turkish University System

There are three university institutions in Turkey which may be called traditional. These are the University of Istanbul, Istanbul Technical University and the University of Ankara. They are all organised on the classical German model, power being

vested in a rector, a senate, and in individual faculties; although as public institutions staffed by civil servants they have a guaranteed autonomy. One new university at Izmir (founded in 1955) is also organised on a similar basis. There are three other new universities which both in conception and organisation have sought to depart from this traditional form. The first of these is the Middle East Technical University (M.E.T.U.), which is a prestigious institution founded in 1958 and designed as an international centre of research. The Rector has wide latitude of action in developing the university under the authority of a Board of Trustees. In contrast to other universities, M.E.T.U. can employ teachers, including foreigners, on a limited-term contractual basis. The second new university, the Ataturk University (at Erzurum in north-east Turkey) was also inaugurated in 1958. It has less autonomy than the old universities: the first appointments were made by the Minister of Education. The University was intended to be based on the United States "land-grant" system; and of its initial two faculties one was agriculture. Under a formal agreement, a special relationship was established with the University of Nebraska in the United States for it to provide technical assistance to the Ataturk University over a period of 10 years. The last new and non-autonomous university is the Black Sea Technical University, which began teaching in 1963-64. Finally, in 1967, the Hacettepe Faculty of Medicine split off from the strictly traditional Ankara University to form the basis of a new basic science oriented Hacettepe University.

The total number of students enrolled in universities more than doubled in the decade between 1956-57 and 1966-67. In the first of these years the enrolment was 33,836, in the second 67,195. The distribution of students by subject in 1966-67 was as follows:

PERCENTAGE DISTRIBUTION OF UNIVERSITY ENROLMENTS (1966-67)

<u>Pure science</u>	<u>Technology & Architecture</u>	<u>Agriculture</u>	<u>Medical sciences</u>	<u>Humanities and Arts</u>
12.2	9.9	5.7	16.0	22.2
	<u>Education</u>	<u>Social sciences</u>	<u>Law</u>	<u>Others</u>
	6.0	8.3	19.2	0.3

In other words, about 44 per cent of students were enrolled in scientific, technical, medical and agricultural subjects.

A major problem of Turkish universities is the enormous pressure of demand for places. The 15,000 or so new entrants annually must be chosen from some 70,000-80,000 applicants for places. Although it is proving necessary to admit increasing numbers, this is resulting in a deteriorating student/teacher ratio, and hence a deterioration in the quality of education.

In actual fact, teaching seems to be largely restricted to mass lectures and the mechanical pursuit of outdated curricula, although this is not true of all the new institutions.

"If the students of today are taught in the same way, those among them who become teachers are likely to continue to practice the same methods and transmit them to their students in turn. This suggests that the essential point in the system where a change, which can have repercussions throughout higher education,

should be carried out is the stage where university graduates are trained to become members of future teaching staff." (1)

Therefore, according to this experienced academic teacher and administrator, the major possibility of reform lies in the postgraduate cycle of higher education.

(b) Postgraduate Education

The process of preparation for an academic post in Turkey is based upon the production of two theses. In the first stage, students prepare their Ph.D.'s generally whilst employed as professional assistants in universities. (In the social sciences it is not uncommon for those preparing theses to be employed in government.) The amount of formal instruction is probably minimal, although in the social sciences 1-2 years of courses are often provided, and there is little doubt that theses are exceedingly variable in quality. The duration of this stage of the preparation is limited, at least for those employed as university assistants. These have to finish their doctoral theses in four years from receiving their job or they are replaced. To quote Okyar again:

"I would suggest that the lack of systematic training and other deficient arrangements at the Ph.D. level are the most important factors influencing the standards and capacities of prospective university teachers. The arrangements for the Ph.D. degree tend to perpetuate enfeebling, archaic practices derived from the past..."

Further information on academic research and postgraduate information is available from the Pilot Team study (2). Information given there shows that almost all academic research is geared to the production of theses, and that there is almost no planned long-term research (pp. 208-11).

The second stage of preparation at the postgraduate level involves the preparation of a second thesis and an examination conferring the title of "docent" and the right to lecture. The whole process takes some 10-12 years. As has been pointed out, severe doubts have been cast on the quality of the overall education given, particularly relevant if it is by an upgrading of the quality of academic staff that overall improvement is to be achieved. Because there is little research other than the preparation of theses, standards are low; furthermore, the number working on theses in individual institutes is very small (see Table VII) so there is little opportunity for informal discussion of research problems and cross-fertilization of ideas.

This is a particular problem in the scientific and applied scientific fields. Although in the majority of subjects there is no master's degree intermediate between the first degree and the Ph.D., this is not true of engineering. In M.E.T.U., for example, the pre-existing five-year degree course has been divided up, so that a first qualification is awarded after four years and a master's degree after five. In fact, engineering education at these levels is probably relatively healthy. The provision of scholarships for doctoral study abroad (see below) has been curtailed in civil and mechanical engineering because it is felt that the possibilities of study within Turkey are adequate.

(1) Osman Okyar: "Universities in Turkey", Minerva VI (2), 1968, p. 226.

(2) "Scientific Research and Technology in Relation to the Economic Development of Turkey" (OECD DAS/SPR/68.40, 1968 mimeo.).

TABLE VII

M.Sc. DOCTORATE AND DOCENT THESES COMPLETED
1962-65 IN THE SCIENCES

Field	No. of Institutes	No. of Theses	Average No. of Theses per Institute	Yearly Average
Medicine	72	608	8.4	2.1
Engineering	42	578	13.7	3.5
Natural sciences	33	122	9.7	2.5
Agriculture	49	275	5.5	1.5
All	196	1,583	8.0	2.0

(c) Postgraduate Study Abroad

The first Five-year Development Plan provided for the sending abroad of some 1,000 Turkish students for postgraduate studies. Turkish students had long studied abroad, of course, and this was nothing new in conception. However, whilst before World War II, students - mostly in the humanities - had tended to go to France or Germany to complete their studies now they were to go to the United States, principally to study natural sciences and engineering. At the present moment, there are some 1,000-2,000 students pursuing postgraduate work abroad. The majority of these are financed either by the Ministry of Education or by the Turkish Scientific and Technical Research Council (TUBITAK). The TUBITAK programme was initiated some 5-6 years ago, and the distribution by field, etc., tends to follow trends in demand: thus many students at present study physics and electronics. Because the programme is relatively recent, and numbers initially were small, it is difficult to get any accurate assessment of wastage. Relatively recently the Council has established a placement service for those wishing to return. The Ministry of Education requires its scholarship holders to work for two years in Turkey for each year spent abroad.

In the decade 1950-1959, 60 Ph.D.s were awarded to graduates of Turkish universities by United States universities, 40 of these were in the physical and biological sciences. Twenty-seven Ph.D.s were awarded in 1960-61.

(d) Postgraduate Education and Manpower Needs

Even though education to the doctoral level is not an obvious priority in Turkish educational planning and provision, it must not be neglected. Those who are to staff growing universities require training to this level. Furthermore, they require good training, made up of high level instruction and genuine research, if deficiencies in the current university system are to be overcome. The M.R.P. Report on Turkey considered the university teachers "the most critical single category of human resources", and it is essential that they be produced in sufficient numbers. The Report went on ... "The primary conclusion of this report is that the development and full utilisation of teachers for higher education is a prime requisite for the ultimate development of the educational system, and thus for the achievement of established goals for economic and social

developments" (1). The authors calculated that on their projection of enrolments in higher education (Table 29 of the Report), some 15,000 extra higher education teachers would be needed between 1963 and 1977 (Table 30). This is on the basis of an unchanged student/teacher ratio. More than half of these would have to be in medical and technological fields. This estimate (now of course subject to revision) must be compared with the number of doctorates awarded annually, shown in Table VIII.

TABLE VIII

NUMBER OF DOCTORATES AWARDED IN TURKEY 1965-1966

	<u>1965-66</u>	<u>1966-67</u>
Pure science	16	17
Technology and Architecture	33	39
Agriculture	4	1
Medicine	108	103
Humanities and Arts	22	58
Education	0	0
Social sciences	19	15
Law	7	3
Total	209	236

Some expansion of postgraduate education is surely called for, the products of which would initially be entirely channelled back into the higher education system. It could be argued that this is best done in one or two large graduate schools based on the American pattern. There remains, of course, the problem of staffing, as well as capitalising, these in the short-term. TUBITAK has estimated, however, that there are currently some 230-240 foreign-trained Turkish Ph.D.'s now abroad; a large percentage of these would amply meet the requirement. There is no reason why these could not be supplemented by foreign academics on contracts, as is now done at M.E.T.U. The alternative to the creation of these graduate schools is of course to send a larger number of students abroad for doctoral education. While this may be a useful short-term expedient, it is a policy which denies to the Turkish universities many of the benefits which would accrue, by a process of diffusion, from the presence of one or more high calibre graduate schools in their midst. It also raises the possibility of non-return, or of an academic corps whose interests are unrelated to the needs of a developing Turkey.

(1) OECD: Mediterranean Regional Project: Turkey (Paris, 1965), p. 121.

SOURCES OF TABLES

TABLE I	<u>Doctorate Production in U.S. Universities 1920-1962</u> (N.A.S.-N.R.C., Washington, 1963), Appendix II.
TABLE II	<u>Mediterranean Regional Project - Greece</u> (OECD, 1965), Tables 10 and 11.
TABLE III	<u>Development of Higher Education 1950-1967, Statistical Survey</u> (OECD, 1970), p. 389.
TABLE IV	"Science and Development - (National Reports of the Pilot Teams) Greece" (OECD, 1968), Table A-IX-5.
TABLE V	"Science and Development - Greece", Table A-IX-6.
TABLE VI	"Science and Development - Greece", Table A-IX-36.
TABLE VII	"Scientific Research and Technology in Relation to the Economic Development of Turkey" (OECD, 1968, mimeo'd), p. 207.
TABLE VIII	<u>Development of Higher Education 1950-1967, Statistical Survey</u> (OECD, 1970), p.742.